PLASTICS TECHNOLOGY

THE MAGAZINE OF APPLIED ENGINEERING

JUNE 1957

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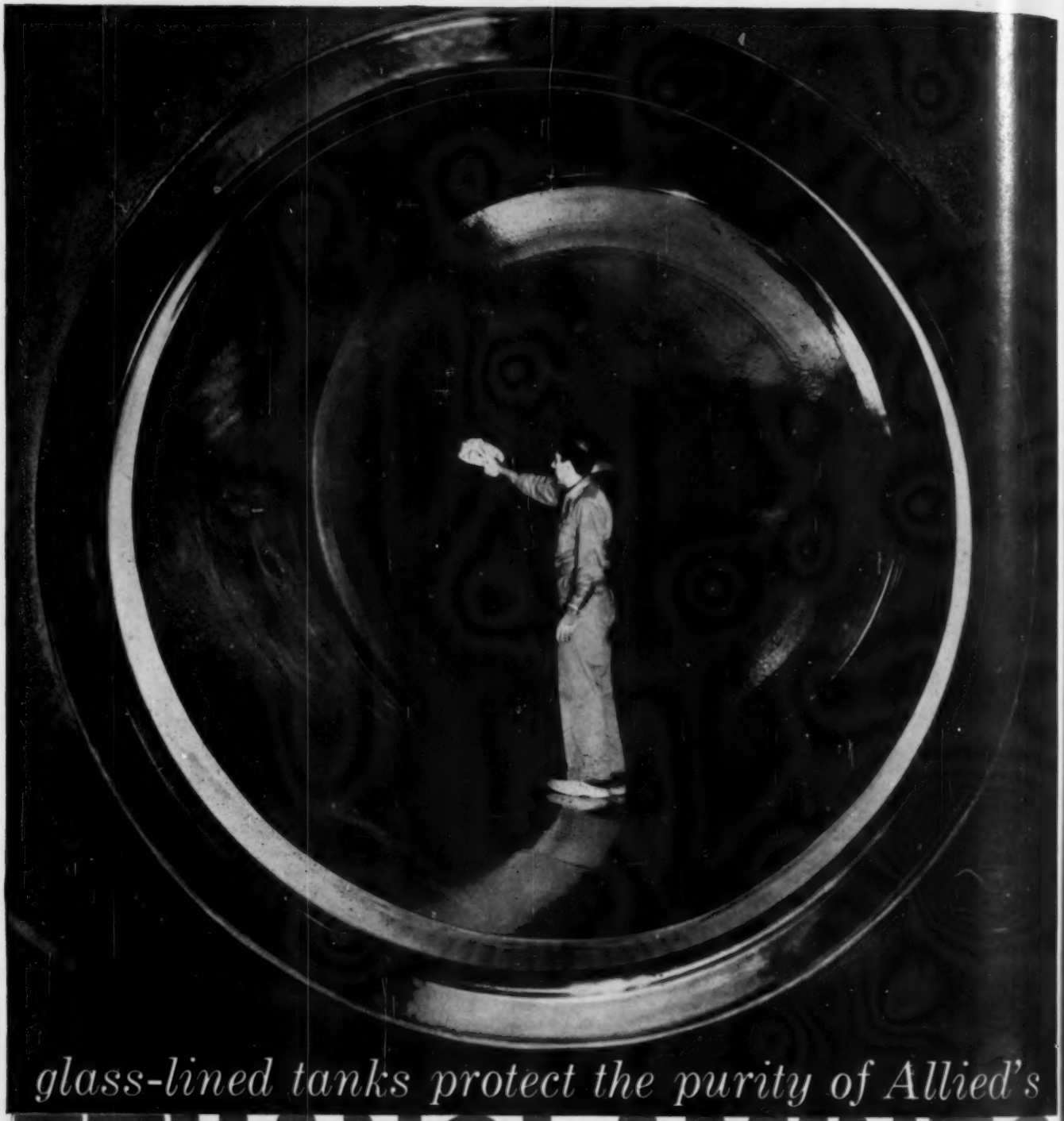
ROTARY FILTERS IN CHICAGO'S SEWAGE TREATMENT WORKS USE STYRENE-COPOLYMER BLEND PIPE

See Feature Story/Page 481

A BELL BROTHERS PUBLICATION



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PLASTICS TECHNOLOGY

THE MAGAZINE OF APPLIED ENGINEERING

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Article

Highlights

Pressure Control of Injection Molding Machines. (p. 459)
Effective pressure control during injection will control the following six variables either completely or in part: granular feed; interrupted molding cycle; and changes in material formulation, plastic temperature, cycle timing, and mold temperature. Degree of control depends on molding situation, placement of pressure gages, and control system used.

•

Extrusion of Nylon 6. (p. 463)
Conditions are given for extruding pipe, film, and sheet. The properties of the extrusions are such as to largely compensate for the added processing costs. These properties include resistance to steam sterilization, and petroleum oils.

•

Sawing and Machining Glass-Reinforced Plastics with Diamond-Coated Tools. (p. 467)
Applications of the tools are described, and it is noted that wear is negligible throughout the tools' major service life, with the smoothest cut-finishes obtained when the tool is nearing the warn-out or maximum tolerance stage.

•

Pyrotex Asbestos-Reinforced Plastics. (p. 476)
The properties of Pyrotex felts and mats make them suitable for use in plastics as reinforcements, laminates, and filler materials in combination with phenolic resins. Typical uses are described.

Previews

The following articles will be published in the July issue:

New Methods for Testing Hot Rigidity of Molded Phenolics. H. D. Jost, tech. service engr., Chemical Materials Dept., General Electric Co., Pittsfield, Mass.

Polyester Resins from Citric Acid. A. Bavley, supervisor, and C. J. Knuth, research chemist, Chemical Research & Development Dept., Charles Pfizer & Co., Inc., Brooklyn, N. Y.

Plastic Compounds Make Molds for Vacuum Forming. G. T. Morse, v-p, Smooth-On Mfg. Co., Jersey City, N. J., and M. S. Schwartz, pres., Emet Plastics Corp., Bronx, N. Y.

Cutting Plastics with Portable Electric Tools. J. L. Bennett, mgr., Engineering Research Div., The Black & Decker Mfg. Co., Towson, Md.

Guest Editorial: **A Time to Sell,** By J. E. David, gen'l. mgr., The Fiberite Corp., Winona, Minn.

Letters to the Editor

Correction for April Calendar

Dear Sir:

On page 332 of your April issue, you list under coming events the British International Plastics Exhibition from June 10-20.

On the strength of this announcement, I have rearranged my schedule for my European trip, only to be advised by the BPE management this plastics show is scheduled for July 10-20. I have been able to arrange my trip schedule back to the original without too much trouble, but may wish to call your readers' attention to this error in dates.

W. R. Reinbacher
"Delrin" Product Section,
Polychemicals Dept.
E. I. du Pont de Nemours & Co.
Wilmington 98, Del.

(Our abject apologies to Mr. Reinbacher for the error and the inconvenience caused him. Our announcement, on which the Calendar item was based, plainly stated July 10-20 as the date of the British exposition. Apparently, someone or something preferred the erroneous June date, even though calendar listings in the March and April issues were accurate.—Editor.)

• • •

Plastics Manufacturers Wanted

Dear Sir:

I have a "Spill-Proof Container and Dispenser" to be used in amusement parks, theaters, or in automobiles when traveling. I am interested in contacting plastic manufacturers that manufacture the following items:

Pint size plastic bags
Plastic straws
Plastic bands

I am writing to inquire if you could supply me with a list of plastic companies that manufacture these particular items, or if you would advise how I could obtain such information.

F. T. Shaw
Denver, Colo.

(Can our readers offer any assistance in this matter?—Editor)

• • •

Wants Tygon-Like Tubing

Dear Sir:

We are interested in learning, if possible, who in the trade manufactures Plastic Tubing like or similar to Tygon Tubing, a product of U. S. Stoneware.

We would appreciate very much receiving this information, if available.

H. E. Uland
Uland Rubber & Supply Co.
Louisville, Kentucky

(Suggestions from our readers are invited to answer this request.—Editor).

• • •

Corrects "New Materials" Write-Up

Dear Sir:

We were pleased to note on pages 221-2 in your March issue the story on the Ray-BOND adhesives made by Raybestos-Manhattan, Inc. The story was very complete and, with one exception, was true.

The exception is in the first sentence of the article. Here, you refer to "A list of eight thermosetting and one thermoplastic adhesives. . . ." We assume that you got this information from the table of adhesives in Bulletin 650A, published by Raybestos-Manhattan, Inc. It is stated at the top of this table, however, that "Here are just a few of the many adhesives, coatings and sealers available . . ." Actually, the adhesives listed in the table are representative of the major classes of adhesives manufactured by Raybestos-Manhattan.

Dan Davis, Pub. Rels. Dept.
Gray & Rogers
Philadelphia, Penna.

(We gladly stand corrected. The implication was taken hastily for a fact.—Editor)

We invite letters from our readers for publication in these columns. Such letters may be of comment or criticism, requests for information, or of general interest. The only requirement is that all letters must be fully identified as to name of sender, company affiliation, and address.

A letter will not be printed if publication is not desired by the sender, and the identity of the writer will be withheld, if desired.

—The Editor

"Quote . . . Unquote"

Woven Plastic Fabrics

"My discussion of 'Woven Plastic Fabrics' is an extremely narrow one since it eliminates films and sheetings, both supported and unsupported, and it similarly eliminates the great majority of those wonder fabrics of man-made fibres.

"Potential utilization for woven plastic fabrics have, in my opinion, been thoroughly and completely investigated. The uses . . . do not compare in volume with that in automobile seat covers, automobile original body cloth, and specialized industrial fabrics, including aerial gunnery targets. In all combined areas, though, the growth potential seems small. As a result, there is considerable development by the textile firms to combine these 'plastic' yarns in their three types (monofils, continuous filaments, and spuns) with other, more normal textile fibres. By this, certain attributes are lost, but others are gained. The volume, in yards and pounds, may well increase, but the designation, I feel, will be lost. Thus, 'Plastic Fabrics' will, within a short time, never carry the prefix 'Woven,' and the terms will be applicable only to films and sheetings, supported or not. What are today designated as 'Woven Plastic Fabrics' will become 'man-made' or 'synthetic' textiles. Thus will our oldest industry (textiles) have absorbed a portion of one of our newest."

J. F. Nicholl, Vice Pres. & Gen. Mgr., Lumite Div., Chicopee Mills, Inc., New York, New York

• • •

Urethane Foams in the Home

". . . . Rigid urethane foams, because of their light weight, high strength-weight ratio, and excellent vermin and mold resistance, have left the starting blocks in the race with other cellular plastics for the home building field. Their ease of application at the fabrication plant as core materials in various constructions and their ability to adhere to most substrates when foamed-in-place at the job site are expected to give the urethanes momentum to win the race going away.

"Flexible urethane foams, pushed forward by recent developments using polyethers, because of their wide range of densities and compression resistances, are forging to the front for use in comfort cushioning. The ideal resilience of polyether foams in addition to the excellent chemical and solvent resistance of all urethane products are plus values that cannot be neglected."

J. W. Hull, Tech. Sales, National Aniline Div., Allied Chemical & Dye Corp., Buffalo, New York

3 BETTER * WAYS TO HANDLE *Plastic Film* PROCESSING!

*BETTER QUALITY — BETTER SPEED — BETTER PROFITS.

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full width
spread control
Mount Hope
FREE WHEELING® EXPANDERS

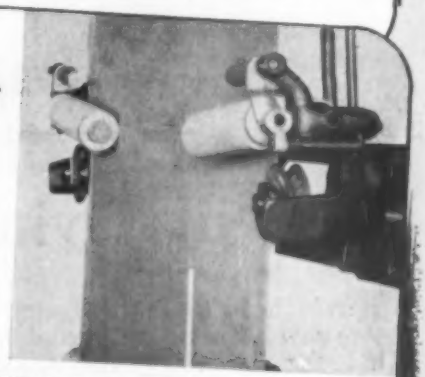
• Assure Maximum Width • Eliminate Wrinkles and Distortion
• Provide Uniform Tension • Cut Waste — Boost Profits.

If you are not getting uniform, unfailing width-wise stretch, in handling your plastic film of any thickness, including the lightest in weight, you are using out-moded equipment that is costing you money. It's high time you investigated the Mount Hope 'Free Wheeling" EXPANDERS, with the patented "magic" action that speeds production and guarantees quality by constantly increasing or restoring original width, while smoothing wrinkles, along with most of your handling problems. Let a Mount Hope engineer tell you what they can do for you.

Write for folder on "Free Wheeling" EXPANDERS

FOR PERFECT ALIGNMENT
Mount Hope PRECISION GUIDERS

*Precise Lateral Movement Guidance — Completely Automatic * Covered with Soft, Sure "MH-31" for Gentle, Safe Handling.



Mount Hope PRECISION GUIDERS provide unfailing, precise alignment guidance of the heaviest or the most fragile film, without supervision. A pair of nip rolls on each edge exert constant, yet gentle pressure—thanks to their covering of soft, rubber-like "MH-31"—an exclusive Mount Hope development — while a grooved and fluted wheel acts as the "sensing" element, controlling correct angle of the rolls. These super-precision guiders save film—save quality—save time and money.

Write for PRECISION GUIDERS Folder 28793

MOUNT HOPE MACHINERY COMPANY
15 Fifth Street, Taunton, Mass. Plants at Taunton, Mass. and Charlotte, N. C.

New "Dutch Boy" Stabilizer team... new quality for automotive grades of vinyl film and sheeting

Here's the latest from "Dutch Boy" research . . . two new "Dutch Boy" Stabilizers especially suitable for automotive vinyls, including "clears".

Flomax* 25 . . . a new and different barium-cadmium organic complex . . . remarkable for clarity, for economy. Flomax 25 gives you outstanding heat and light stabilization combined with freedom from yellowing and plate-out.

Nalzin* is an effective new zinc organic co-stabilizer that prevents sulfur staining.

In calendered stocks, these "Dutch Boy" non-lead Stabilizers team up to assure quality that reaches or exceeds automotive standards. What's more, they do so with outstanding economy.

Both, for example, are easy to incorporate and disperse. They're liquid . . . miscible in and compatible with common plasticizers and solvents.

Both are ideal, too, for cost and efficiency . . . suitable for high-quality, low-cost formulations.

Where unusually high heat stability is a requirement . . . or sheeting is unusually heavy . . . other "Dutch Boy" barium-cadmium Stabilizers, Provinite*, and Clarite* are widely used. Both provide an extra measure of heat stability.

If you produce automotive or furniture upholsteries, luggage or heavy-duty film stocks, you may want to know more about these and other "Dutch Boy" Stabilizers for vinyls. A new "Dutch Boy" Stabilizer Handbook gives full details, including formulae. Write for a copy.

National Lead also provides technical assistance in the use of these "Dutch Boy" Stabilizers.

Dutch Boy® CHEMICALS

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630 Dorchester Street, West, Montreal

NEWS in BRIEF

Automation in decorative spraying of plastic auto speedometers and clock dials has resulted in a labor savings of more than 75% for a Chicago injection molder and fabricator. The new set-up uses a turn-table, four spray nozzles, and a single spray mask, and one operator can spray simultaneously with four colors. An individual spray method was previously used.

More efficient utilization of scientists by industry can relieve the acute scientific manpower shortage, according to Frank Pray, president of Technicraft Co. (see guest editorial, page 466). He states that many scientists are required to spend much valuable time doing secondary chores that could be handled by a well-chosen team of assistants. Near-scientists in industry should be allowed to work to their fullest ability, paid accordingly, and granted a professional status of which they can be proud.

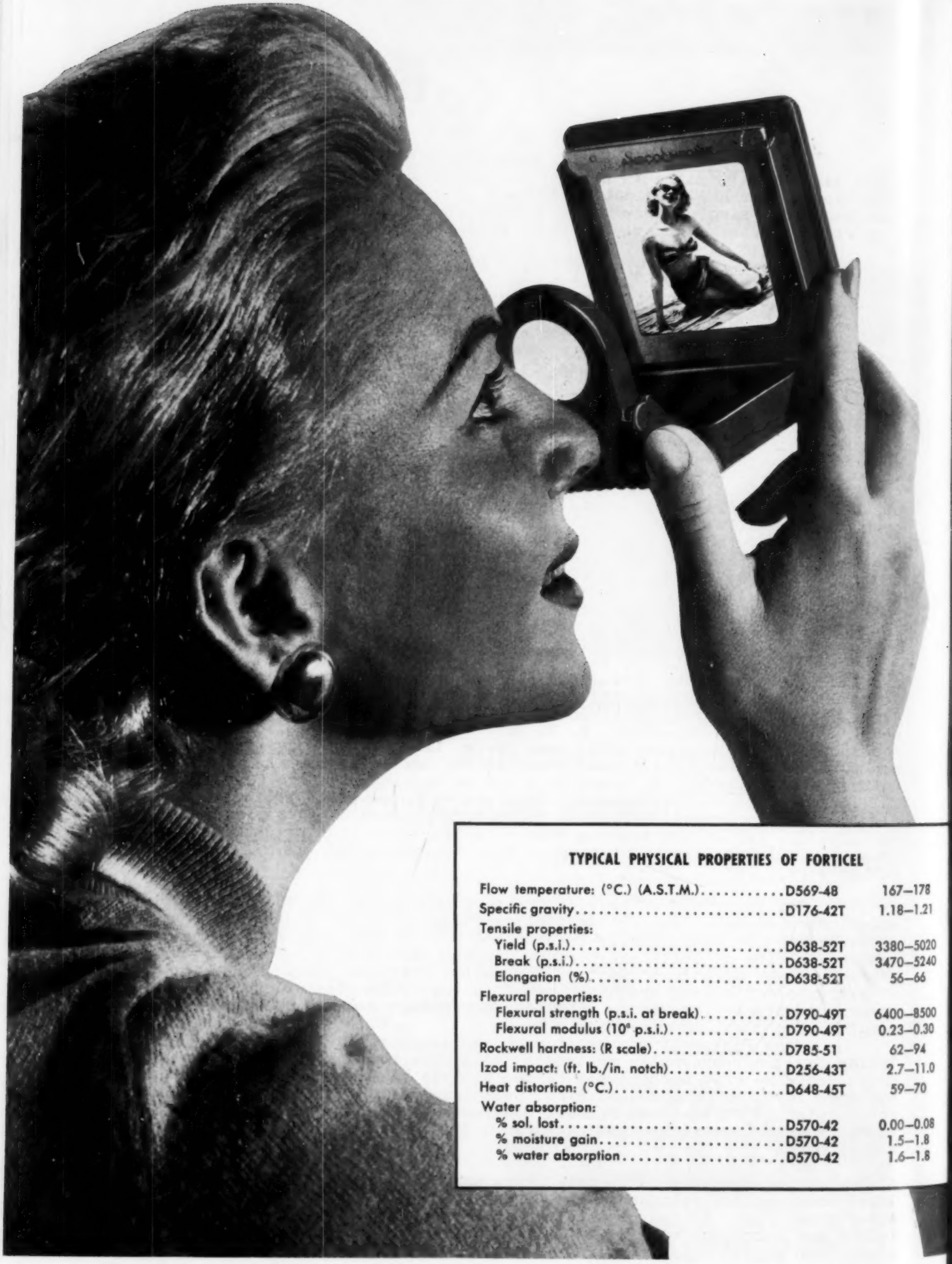
Company developments in plastics were not few in number. A new corporate name, Continental-Diamond Fibre Corp., was adopted by Budd Co.'s former Continental-Diamond Fibre division. A new company, Fiber Glass Industries, Inc., purchased the fiber glass and reinforced plastics operations of Bigelow-Sanford Carpet Co. in Amsterdam, N. Y. Lawrence Process Co., plastics extruders, was acquired by Borden's chemical division, and will operate as a wholly-owned subsidiary. Lord Chemical set up an experimental center in York, Pa., for barrel finishing of plastics and metals. Pro-phy-lac-tic.Brush purchased the Propper-McCallum plant in Florence,Mass., for additional manufacturing and storage use. Weber.Plastics,.Inc., is a new entry into the plastics molding field.

Company expansions in the news this month were numerous. Air Reduction Chemical will build a new plant at Calvert City, Ky., to make vinyl stearate in commercial quantities. Carbide Chemical will double acrylonitrile output at its Institute, W. Va., plant. Du Pont is building a new sales-service lab at Chestnut Run, Del., and plans a new cellophane plant near Tecumseh, Kans. Escambia.Chemical is erecting a research center in Wilton, Conn. General Electric's silicon products dept. is constructing a new development lab in Waterford, N. Y. Goodrich Chemical is building a new plant for specialty organic chemicals near Henry, Ill. Lester-Phoenix completed a new building for machining operations on its injection molding and die-casting units. Metal.&.Thermit is erecting a new processing plant in Carrollton, Ky. Phillips' new plant near Houston, Tex., is in large-scale production of the firm's high-density polyethylene. Polymer.Corp. opened a new plant in Santa Ana, Calif., for custom coating work with plastics. Stanley Chemical set up an injection molding department at East Berlin, Conn., that is available for custom work

New Materials of special interest (see pages 498-500): four silicon intermediates; two colloidal dispersions of carbon black; high-density polyethylene; 10 mechanically-interlocked felts; two lead-filled plastic compounds; line of cellulose acetate powders for molding and extrusion; series polyether-base prepolymer systems for making urethane foams; monomeric phthalate plasticizer; synthetic paraffin wax; polyamide extrusion compounds; color concentrate for use in plastics decorating; and two epoxy resins.

New Equipment worthy of mention (see pages 501-3): forming and finishing tool; air-hydraulic cylinders; adaptable forming press; improved panel saws; draw and trim machine for formed plastic box covers; preplasticizer-equipped injection molding machine; redesigned grinder for plastic molded scrap; plastic strip-stock feeder; heavy-duty twin-drum tumbler; pocket-size hardness gage; cartridge-type electric heating elements; and wear-resistant router bits.

New Products to be noted (see pages 504-5): small-instrument housings; press-molded reinforced-plastic sheets; globe-type butyrate valves with non-rising stems; formed plastic doors for refrigerator units; expansion joints and couplings with tetrafluorethylene bellows; complex custom extrusions; and molded nylon couplings for miniature electric railroads.



TYPICAL PHYSICAL PROPERTIES OF FORTICEL

Flow temperature: (°C.) (A.S.T.M.)	D569-48	167–178
Specific gravity	D176-42T	1.18–1.21
Tensile properties:		
Yield (p.s.i.)	D638-52T	3380–5020
Break (p.s.i.)	D638-52T	3470–5240
Elongation (%)	D638-52T	56–66
Flexural properties:		
Flexural strength (p.s.i. at break)	D790-49T	6400–8500
Flexural modulus (10^5 p.s.i.)	D790-49T	0.23–0.30
Rockwell hardness: (R scale)	D785-51	62–94
Izod impact: (ft. lb./in. notch)	D256-43T	2.7–11.0
Heat distortion: (°C.)	D648-45T	59–70
Water absorption:		
% sol. lost	D570-42	0.00–0.08
% moisture gain	D570-42	1.5–1.8
% water absorption	D570-42	1.6–1.8

PLASTICS TECHNOLOGY

JUNE, 1957

EDITORIAL: Are We Designing for Plastics?

While reviewing some of our past editorials, we were struck by the thought that many are just as timely now as they were when originally published. Reprinted below is our April 1955 editorial on "Designing for Plastics." After reading this editorial, can we give an honest, all-inclusive "Yes" answer to the question, "Are we designing for plastics?"

•

The color and other glamor qualities of plastics, being self-evident from the start, led to initial use of these materials in applications where decorative features were the determining factors. Fortunately, many of these applications were also sound engineeringwise, and helped provide the impetus needed by the young industry.

Unfortunately, however, some of these initial uses were not good engineering. Neither were some of the applications developed as the young industry began to spread its wings and look for new fields to conquer. Most of these misapplications arose from insufficient understanding of the materials and their proper use.

The greatest potential for plastics now lies in engineered products for industrial and consumer use. Here, plastics must compete with older materials whose properties are well known, and are used in parts designed for these older materials.

The accumulation of more engineering data on plastics is only half the battle. Given this data, we must design products for use with plastics. This may seem elementary, but is it?

A study of any product reveals that it is designed for the material from which it is made. Familiarity with the product over the course of years often obscures recognition of this blending of material properties, product service requirements, and part design.

When plastics are considered for use in a specific product, the natural tendency is to use them as replacements for the older materials. Sometimes such materials replacement works; more often it does not. We need to design the part for plastics.

•

Plastics design starts with complete knowledge of the material's properties and the product's service requirements. When these correspond, the next step is to consider how manufacturing and fabricating techniques for the plastic can affect the product's efficiency and costs. Finally, the part should be studied to determine whether it can be redesigned to take fuller advantage of the plastic material.

In simplest terms, such redesign can consist of adding reinforcing ribs; using different radii, tapers, and tolerances; or incorporating features to hide parting lines. In the more complex cases, it can mean the design of a new part that looks strange to our eyes, yet is functionally excellent.

Designing for plastics requires education of both the plastics industry and the consuming industries. Perhaps the world of tomorrow will look futuristic and different because its components have been redesigned for full utilization of plastics.

Arthur M. Merrill

Editor

JUNE
1957

Plastiatrics

DOW'S CLINICAL APPROACH TO HEALTHY PLASTICS APPLICATION

RESEARCH DETERMINES CHEMICAL RESISTANCE OF DOW PLASTICS

A typical test under way in the Dow Plastics Technical Service laboratory. This "dunking machine," designed by Dow technical men, tests finished plastics moldings under accelerated use conditions. Any cycling schedule desired can be established on each of its five stations.

ABILITY OF DOW PLASTICS TO WITHSTAND ATTACK BY MORE THAN 350 CHEMICALS TESTED

Industry has recognized the important role of plastics. And, as the range of application possibilities increases, the chemical resistance of these plastic materials becomes critical. The ability of a plastic to withstand chemical attack by certain specific reagents often determines the selection for a given application.

The Dow Chemical Company, as a major supplier of plastic materials to industry, has recognized this problem. Under the direction of Dow Plastics Technical Service, a program of exhaustive tests has been under way for a number of years to provide fundamental data on the chemical resistance of all Dow plastics. More than 350 different chemicals and food ingredients, for example, have been tested to determine their effect on the numerous Styron® formulations. Similar data has been collected on Saran, Ethocel®, Styrex® 767, and Polyethylene.

This data has proved invaluable to manufacturers in making a proper selection of plastic materials for specific applications. Plastiatrics studies and research continue in this and similar areas in an effort to find practical solutions to problems in plastic applications. For your copy of "Chemical Resistance of Dow Plastics," write THE DOW CHEMICAL COMPANY, Midland, Michigan, Plastics Sales Dept. PL 1543K.

AMERICA'S FIRST FAMILY OF POLYSTYRENES

GENERAL PURPOSE
- STYRON 666
- STYRON 665 (Extrusion)
- STYRON 688 (Easy Flow)
- STYRON 689 (Easy Flow)

HIGH IMPACT
- STYRON 475
- STYRON 777 (Medium Impact)
- STYRON 440 (Heat Resistant)
- STYRON 480 (Extra-High Impact)

HEAT RESISTANT
- STYRON 683
- STYRON 700

YOU CAN DEPEND ON DOW

PLASTICS TECHNOLOGY

Pressure Control for Injection Molding Machines

Results of tests indicate that better molding quality can be obtained with a system of machine pressure control.

C. E. BEYER, *Group Leader,*
Saran Polymerization Laboratory
Dow Chemical Co., Midland, Mich.

As injection molds become more complicated molded parts become thinner, cycles become faster, and the control system of the machine also must be improved. The plastic in the heating cylinder has been called the compressible plunger which forces fluid plastic from the nozzle, into the mold. The effective length of this plunger and the pressure transmitted to the mold cavity will depend on the conditions that exist in the heating cylinder and the mold.

There are many things that must be controlled between the point where the plastic is being pushed (the plunger) and the end-result of this push (mold pressure). Some of these variables are the mold temperature, the plastic tmperature, the plunger speed and prssure, the cylinder temperature, the granule feed, and the plastic size, shape, lubrication, and viscosity, etc.

Need for Adequate Controls

We know that the main purpose for maintaining control of these variables and the various cycle times is to fill the mold properly and then to maintain the proper pressure sequence in the mold as the plastic

Carlton E. Beyer was born in Toledo, O., on June 9, 1927. He attended the University of Toledo, receiving a B.S. in engineering physics in 1950. He joined Dow following his graduation from college, and has been with the company since that time. He is group leader—applications research in Dow's Saran Polymerization Laboratory. Mr. Beyer is an active member of SPE and the Society of Rheology. Mr. & Mrs. Beyer and their two children live in Midland, Mich.

Based on a paper presented at the 13th annual National Technical Conference, Society of Plastics Engineers, Inc., St. Louis, Mo., Jan. 17, 1957.

cools and solidifies. All of the variables listed above are controlled very closely either by the material manufacturing process or by the molding machine instrumentation, but no instrument is perfect and there will always be some small, random variation in all of these factors.

When all of these small variations are placed between the plunger and the mold, they can add up to a much larger variation in the pressure transmitted to the mold cavity. In a fairly simple, medium-section mold, these variations usually can be tolerated and good moldings made. As moldings become more complicated and sections become thinner, the variations that can be tolerated become smaller. It is in this area of molding where the need for better control of the molding machine becomes apparent.

It is well known that preplasticizer-equipped molding machines, operating at about the nominal rated capacities of the same machines without preplasticators, will produce pieces of better quality, higher density, and improved uniformity on faster cycles. Thus, the preplasticator eliminates the feed granules and the need for a torpedo in the compressible plunger system, giving better and more uniform pressure transmission to the mold. Weigh-feeding has given some of the same improvements by reducing some of the variations in granule feed.

These and other advances in injection molding technology have increased the precision of control by either eliminating the variables or controlling them more accurately. However, very thin-section moldings still present a bad problem in molding machine control. To fill the mold uniformly before the plastic can cool usually requires higher injection speeds and higher injection pressures. If this higher injection pressure were allowed to be transmitted to the full mold, it would either over-pack or flash the mold.

This problem has been partially solved by small quick-freezing gates, weigh-feeding, and the two-step pressure system controlled by timers. If we could be certain that the pressure in the mold would never go above a predetermined level no matter what happened between the plunger and the mold, we could do much more with injection speeds and pressures than is currently feasible with present control systems.

The hydraulic system of an injection molding machine can deliver oil consistently at the correct flow rate and pressure, and is easily controlled. If a pressure-sensing element is placed in the mold cavity, it can then be used to control the oil supply to the injection cylinder. This has the possibility of adjusting the hydraulic system to compensate for the errors and variations between the plunger and the mold cavity.

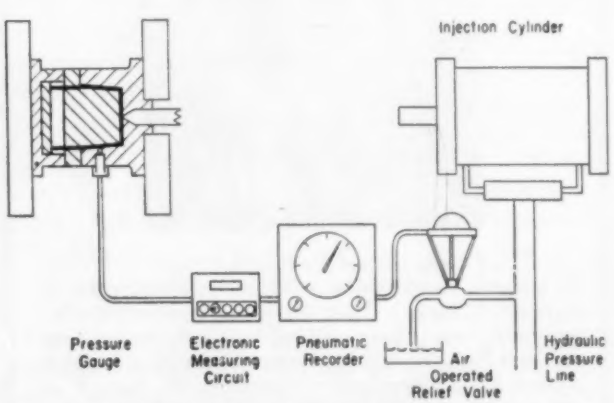


Fig. 1. Schematic drawing of proposed pressure control system for injection molding machines. System has an air-operated relief valve connected to the machine's hydraulic line.

As an example, there is the very common case of a stuck sprue. The machine must be stopped momentarily to remove this sprue. During this time, the plastic in the heating cylinder becomes warmer and flows more easily. If molding were resumed at this point without purging the machine, the result would be too much pressure in the mold. This excessive pressure probably would flash the mold or perhaps cause something even worse. A pressure-sensing element could either cut off the flow of material into the mold or reduce the injection pressure when a predetermined mold pressure is reached. Thus, the mold pressure would not be allowed to rise too high, regardless of the fluidity of the plastic.

With this introduction, we can come to the conclusion that some sort of direct control of mold pressure would eliminate many molding headaches, and also improve the quality and uniformity of some types of molded parts.

Automatic Molding Cycle

The first system set up for controlling the injection pressure consisted of the following (see Figure 1):

(a) A pressure gauge placed in the mold to measure the plastic pressure.

(b) A recorder with pneumatic control.

(c) An air-operated relief valve connected to the hydraulic line of the molding machine.

Because of the slow response of the system and the time lag in the heating cylinder, this system could be used only on fairly heavy-section molds. The system did have one advantage in that extra switches could be attached to the recorder to return the plunger and open the mold, based on pressure in the mold. Another switch, operated by a thermocouple placed in the mold, was connected in series with the mold pressure clamping switch to insure that both plastic pressure and temperature were low enough to open the mold.

The operating sequence of the proposed automatic molding cycle (AMC) is as follows:

(a) The mold closes and the plunger moves forward, filling the mold under full pressure.

(b) When the mold is full and the mold pressure built up, a relief valve opens and drops the hydraulic pressure to some lower value.

(c) As the mold pressure falls off due to contraction of the plastic during cooling, the proportioning action of the recorder gradually increases the hydraulic pressure in an attempt to hold a constant mold pressure.

(d) At some point during cooling, the gate freezes and the mold pressure falls off at a faster rate. The plunger is then returned by a cam on the recorder.

(e) When the mold pressure and plastic temperature fall off to a preset value, the mold opens.

Advantages of Automatic Controller

The four advantages of the automatic controller were as follows:

(1) Easier setting of controls. Only two control settings need be made by trial and error. These are the heating cylinder temperature and the mold pressure control points. The position of the plunger-return and mold-opening switches are determined readily from the mold-pressure record. Some data will be given to indicate that the cylinder temperature is not as critical as in conventional molding techniques. This reduces the time and material needed to get a mold into production.

(2) Automatic compensation for interrupted cycles. When using the automatic controller, the molding cycle can be interrupted for several minutes, and molding then can be resumed to make acceptable parts immediately. In conventional molding techniques, an interruption in the cycle of this sort would require that the overheated material in the heating cylinder be purged out and several bad moldings made before the machine would be back on cycle again. With the automatic controller, the molding cycle could be interrupted for several minutes and molding resumed by simply closing the gate and starting the normal cycle. The first piece made after this break in the cycle was acceptable.

(3) Automatic compensation for changes in the plastic material. With the automatic controller, the injection presssure is adjusted to maintain a uniform mold pressure, regardless of the type of plastic. With this system, any changes in the type of material or its viscosity are automatically compensated for without adjustment of the controls. With an injection molding machine operating on general-purpose polystyrene, the hopper was emptied and filled with high-impact polystyrene. The machine was operated continuously and, after a few minutes, the high-impact polystyrene began to appear in the molding. During the change of materials in the moldings, the controls were not touched, yet with the exception of color, all of the parts made were acceptable. After the change-over was completed, the mold temperature was raised slightly to give a better surface finish.

The automatic controller also will compensate for changes in plastic temperature. In one test, the cylinder temperature was raised from 325-500° F. in 25° F. increments, with sufficient time between increments to establish temperature equilibrium. Good moldings were made consistently throughout the test. The controller did lengthen the cycle to compensate for the longer cooling time required.

(4) Uniformity of piece weight. With the automatic controller, the maximum deviation in piece weight was $\pm 0.07\%$. The best weight uniformity obtained with volumetric feed gave maixmum deviation of $\pm 0.13\%$; and with weigh feeding, a maximum deviation of $\pm 0.11\%$. This system, though ideal in theory, is not too practical for anything but the heaviest of moldings. With thinner parts and faster cycles, a simpler and faster system must be used.

The simpler system would be to place the pressure transducer in or somewhere near the mold cavity, and then use this as a switch to adjust the relief valves or relay operation of the machine. There are several places to put the pressure transducer; also, several things that can be done with the hydraulic operation of the machine. I would like to, in turn, discuss the advantages and disadvantages of the various positions of the transducer and of the method of control.

Placement of Pressure Transducer

There are three obvious positions for the pressure gauge in the plasticized zone of the injection molding machine:

(1) Directly in the mold cavity.

(2) In some auxiliary cavity or in the runner system.

(3) In the nozzle.

The advantage of placing the pressure transducer in the mold cavity is apparent. It is the pressure and temperature sequence in the mold which determines the quality of the molded part. The closer the pressure transducer is to this point, the more accurate the control. This position, however, has some serious disadvantages. Not all molds will have space for a pressure gauge. Normally, a pressure gauge in the mold cavity needs a small plug somewhere in the mold cavity. This plug will produce a ring on the surface of the molding similar to the marks made by the knock-out pins. Also, the deflection of the gauge must be kept very small or a boss will be produced on the molding which may cause the part to stick in the mold.

These disadvantages can be overcome by placing the pressure gauge in the runner system by either cutting an additional runner to an auxiliary cavity which contains the pressure gauge, or by placing the gauge at the end of the sprue. This puts the pressure control outside of the mold cavity, but close enough to get some of the desired results. The major disadvantage of placing the pressure gauge in the mold is cost. Each mold must be made to hold a pressure gauge, and a gauge installed in every mold or changed whenever a mold is changed. The method of overcoming this disadvantage is to place the pressure in the nozzle of the machine. Thus, one nozzle gauge will serve for all molds used in that particular machine.

Placement of the pressure gauge in the nozzle does put some of the variables back which we had hoped to compensate with the control system. These vari-

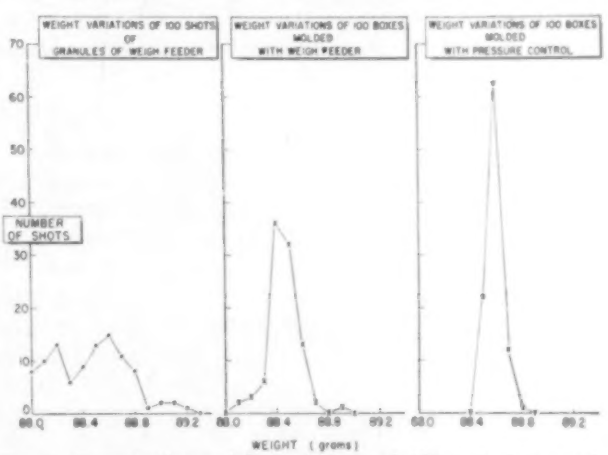


Fig. 2. Comparative weight variations of 100 test shots made with weight-feeding and with pressure control.

ables are the mold pressure and, mainly, the mold temperature. Another difficulty of a pressure gauge in the nozzle is temperature compensation of the transducer because of the relatively higher temperatures it encounters.

Using the Pressure Signal

Once the mold is filled and the pressure built up to the proper level, the pressure gauge will signal back to the hydraulic system of the injection molding machine. There are three things that can be done with this signal, as follows:

(1) Use it to return the plunger. This can be used for very thin-secion moldings with pin-point gates that will freeze off rapidly.

(2) Use it to shift to another pressure-relief value set at somewhat lower pressure. This is useful for medium-section moldings where the shrinkage is not excessive.

(3) Use it to stop the plunger and seal the mold. As the plastic cools and the pressure is reduced, the oil pressure may be exerted again to build up the mold pressure to the proper level. This is, in essence, an attempt to hold the mold pressure at some constant level until the gate freezes off, and is particularly useful with thick molds where a long packing time is required.

Because of the variety of molds and molding requirements and our lack of experience with this control system, there does not seem to be any one system that will do a perfect job in all molding situations. We do believe that any one of the above will give some advantages over conventional injection molding machine controls. The individual molder must analyze his requirements and decide upon the system that will fit his molding methods.

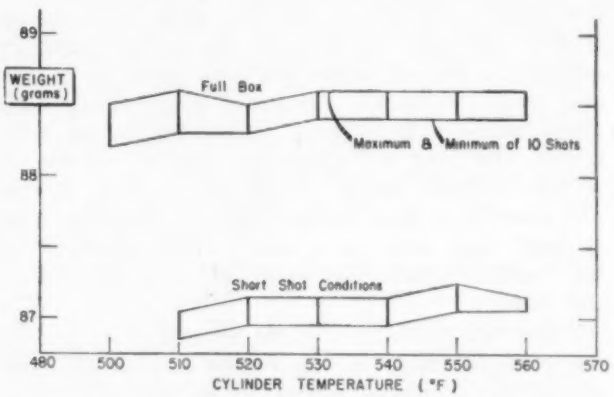


Fig. 3. Effect of cylinder temperature on molded part weight.

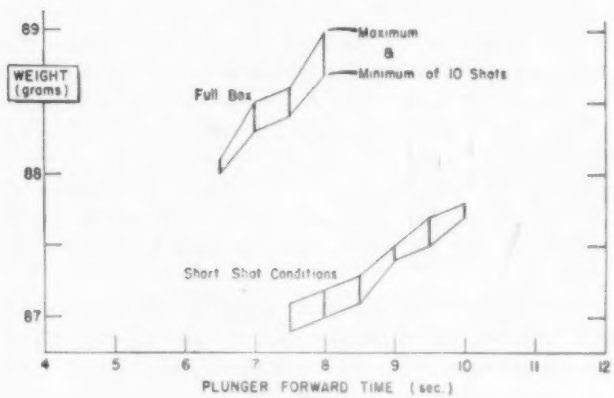


Fig. 4. Effect of plunger forward time on molded part weight.

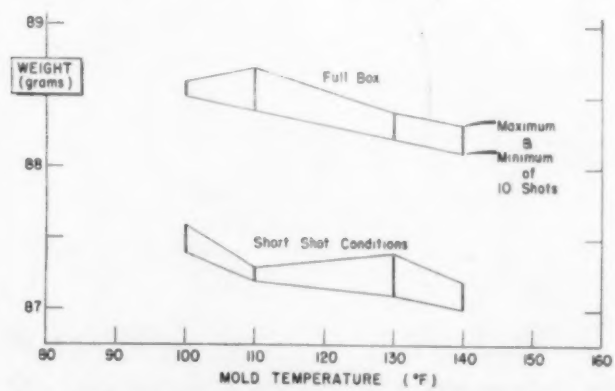


Fig. 5. Effect of mold temperature on molded part weight.

Test Results

To illustrate what this type of control system can do, we can mention some of the results that can be obtained in the simplest case; i.e., using the mold pressure gauge to transfer the control from the booster relief valve set at full pressure to the second-stage control set at one-half of full pressure. The mold was a single-cavity box five inches square, four inches deep, and 0.070-inch thick. It was gated at the bottom with an extended nozzle, and the pressure gauge located in the center of one of the sides. The box weighed about 88½ grams in polystyrene, and was molded on a four-ounce injection machine.

This machine was equipped with a weigh-feeder whose accuracy was ±0.6 gram of granular feed. When molding this part on a conventional cycle, the variation in weight of the part was ±0.4 gram. When the pressure-control system was used, the variation in weight of the part was only ±0.16 grams (see Figure 2). Five other advantages were found for this control system, as follows:

(1) The amount of cushion ahead of the plunger (up to two inches) did not affect the weight of the part.

(2) The machine was stopped for 30-, 40-, and 60-second intervals and molding resumed. The first part molded after resumption was acceptable, although in all three cases this parts was ½-gram heavier than the previous parts.

(3) The part weight did not change with an increase of cylinder temperature from 500-560° F. (see Figure 3).

(4) The part weight increased slightly with longer plunger forward time. (see Figure 4).

(5) The part weight decreased slightly as the mold temperature was raised. (see Figure 5).

To increase the severity of these tests, the initial pressure was lowered somewhat to produce a box that was not completely full. As shown in Figures 3, 4, and 5, the results obtained were identical to those of the previous tests.

Conclusions

In conclusion, some sort of a pressure-control sys-

(Continued on page 480)

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Extrusion of Nylon 6

Material properties are described, and extrusion conditions given for making pipe, blown film, flat film, and sheet.

THE properties of nylon already have been used to good advantage in many extrusion applications. Abrasion-resistant coatings for army field wire and mechanical cable, tubing, and rod are familiar uses of nylon. Nylon resins have been developed recently with sufficient melt viscosity to be processed into blown and flat film, sheet, and pipe, using equipment and techniques similar to those used with polyethylene, the cellulosics, and rigid vinyl. These new applications for nylon will be discussed in this paper.

The most prominent nylons are the so-called 66 and 6 types. Nylon 66 is a polymer of adipic acid and hexamethylenediamine. Nylon 6 is a polymer of epsiloncaprolactam. Nylon 66 has been widely used in the United States, whereas nylon 6 has enjoyed the favored position in Europe.

Spencer nylon is a 6-type nylon. By changing the conditions of polymerization, the melt viscosity of the polymer may be varied within limits. Thus, it has been possible to develop a nylon resin with sufficient melt viscosity for most extrusion applications.

Material Properties

Some basic physical properties for a Spencer nylon extrusion grade resin are shown in Table 1. The test specimens were conditioned to a 2% moisture content.

Nylon has good chemical resistance to alkalis and petroleum oils, and is insoluble in common solvents and most organic acids. Nylon is attacked by mineral acids, however, and may be dissolved in hot formic acid or molten phenol. Some 30-day immersion data are presented in Table 2. The specimens were weighed both prior to immersion, and after removal from test. The test specimens were attacked vigorously by sulfuric, nitric, and hydrochloric acids, while the remaining chemicals used in the test had little, if any effect.

Extrusion

As is true with other plastics, to extrude nylon it is necessary to be familiar with the melt characteristics of the polymer. A comparison between the plasticizing range of polyethylene and nylon is shown in Figure 1.

Nylon 6 type resins have a comparatively sharp melting point at 420° F., and the viscosity changes abruptly over a 7-10° F. range. As the temperature is raised further, the viscosity remains nearly constant. On the other hand, polyethylene has a wide plasticizing range, and slowly decreases in viscosity over a

Based on a paper presented at the 13th annual National Technical Conference, Society of Plastics Engineers, Inc., St. Louis, Mo., Jan. 17, 1957.

Table 1. Physical Properties of Spencer Nylon 600.

	ASTM Test Method	Test Value
Tensile strength, psi.	D638	9900
Elongation, %	D638	300
Impact strength, ft.-lbs./in.	D256	1.8
Stiffness, psi.	D747	155,000
Flow temp., °F.	D569	420
Heat distortion temp., °F.:	D648	
at 66 psi.		291
at 264 psi.		163
Specific gravity	D792	1.14

125-150° F. range. Although the plasticizing range of nylon 6 is only a few degrees, the polymer is stable over a 100° F. range, which allows ample processing latitude.

With the melt characteristics of nylon 6 in mind, let us turn to the design of the screws used in nylon extrusion. Two types of screws are shown in Figure 2; Type #1 is the DuPont-designed screw used in the United States, while Type #2 is the A.K.U.* designed screw used in Europe. The major difference between the two designs is the treatment of the compression section of the screw. Both designs, however, work very satisfactorily with nylon 6.

The temperatures of the various sections of the extruder must be controlled carefully so that premature melting of the granules does not occur. Typical temperatures of the three sections of the extruder are shown in Figure 3.

Applications

Pipe

Nylon pipe is being extruded in size from ½-5½ inches. A conventional pipe die used for polyvinyl chloride or polyethylene is suitable. The pipe is externally sized, using a vacuum sizing die. A typical extrusion set-up for one-inch nylon pipe is shown in Figure 4.

The temperature of the melt leaving the die is 450-480° F. Slight air pressure may be maintained on the inside of the pipe, and the vacuum sizer is located one inch from the die. The amount of vacuum maintained on the sizing die will vary with the take-off speed and size of pipe, but 5-7 inches of vacuum usually are sufficient. After going through the sizing die, the pipe successively passes through a short water-cooling tank, a take-off, and automatic sawing equipment.

The combination of strength, heat resistance, and chemical resistance offered in nylon 6 makes it a very attractive pipe material. Long-term burst data on

*Algeme Kunstzijde Unie N. J., Arnhem, Holland; screw manufactured by A. Reifenhauser, Troisdorf, West Germany.

Table 2. Chemical Resistance of Spencer Nylon 600 after 30 days at 73° F.

Immersant	Weight Change, %	Ultimate Tensile, Psi.
Sulfuric acid, 30%	11.83	1,850
Nitric acid, 10%	*	*
Hydrochloric acid, 10%	*	*
Sodium hydroxide, 10%	3.28	11,600
Carbon tetrachloride	0.70	8,450
Ethanol	4.25	11,400
Toluene	0.53	9,950
Lubricating oil, SAE	0.44	12,400

*Could not be measured.

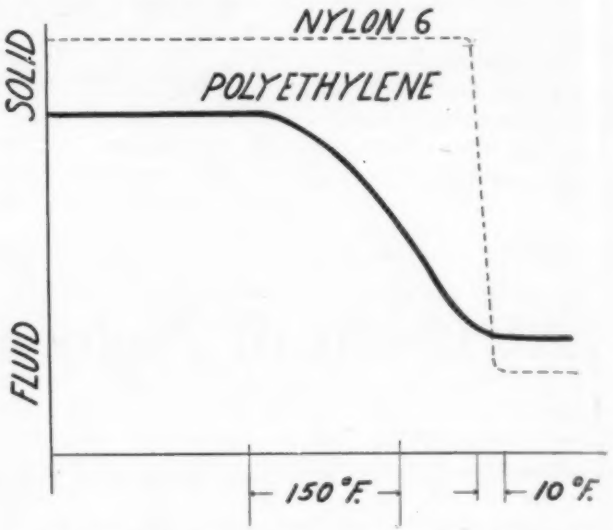

Fig. 1. Comparison of melt characteristics of nylon 6-type resin and polyethylene.

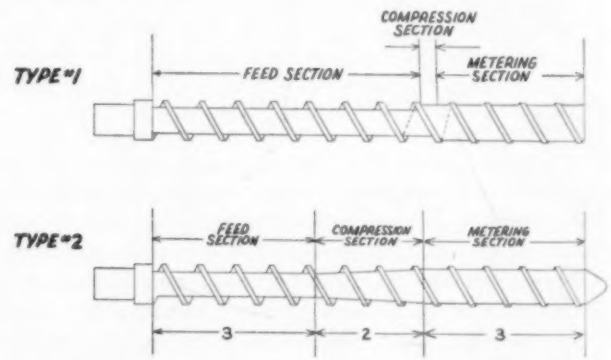

Fig. 2. Two extruder screw designs for nylon: Type #1 is DuPont design used in United States; Type #2 is the A.K.U. design used in Europe.

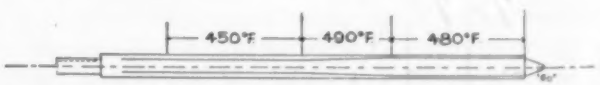

Fig. 3. Typical temperatures of extruder screw sections for nylon 6 extrusion.

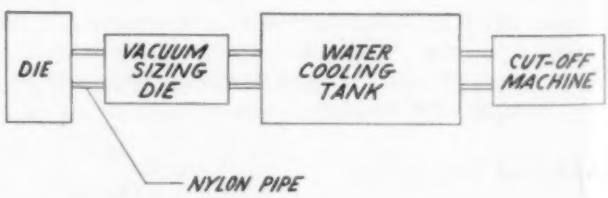

Fig. 4. Schematic drawing of typical extrusion set-up for one-inch nylon pipe.

Table 3. Comparative Properties of Specer Nylon 600 Flat and Blown Films

	ASTM Test Method	Blown Film*	Flat Film
Ultimate tensile strength, psi.:			
Machine direction	D882**	8,400	7,700
Transverse direction		9,300	6,500
Yield point, psi.:			
Machine direction	D882	5,200	3,600
Transverse direction		5,500	3,500
Elongation, %:			
Machine direction	D882	320	300
Transverse direction		300	250
Elmendorf tear strength, gms./mil.:			
Machine direction	D689	30	60
Transverse direction		40	50

*Blow-up ratio, 2.4:1.
**Test run at jaw separation rate or two inches/minute.

nylon 6-type pipe is not available at this early stage of development; from quick burst tests, however, the maximum allowable material stress may be calculated. The effect of temperature on the material stress is shown in Figure 5. The data was taken at a 2% moisture content in the nylon.

Nylon 6-type pipe will absorb up to a maximum of 9.5% moisture when immersed in water. In air, under normal conditions, the moisture content will be 2-3%. The effect of moisture on the maximum allowable stress is shown in Figure 6.

Blown Film

Blown nylon film may be processed using the standard techniques developed for polyethylene film. The suggested extrusion temperatures for a 2½-inch extruder operating at a rate of 40 pounds per hour are:

Rear zone	460° F.
Middle zone	500° F.
Front zone	500° F.

The die temperature is controlled at 470° F. A screen pack of six 120-mesh screens sandwiched between two 80-mesh screens is recommended. We have found it advantageous to have the inside die lip about 0.020-inch higher than the outside lip. This prevents, to a large extent, the tendency of the nylon film to stick to the inner lip, causing tears in the film. An air cooling ring** with multiple air-inlet ports should be located one or two inches above the die. The distance required between the die and the pinch rolls on the take-off equipment will be 8-10 feet. To guide the film from the die into the pinch rolls, a chute should be constructed from plywood or fiberboard. The bottom of the chute should be about one foot above the die.

Nylon blown film has good clarity in gauges of one mil or less. The film has much greater stiffness than polyethylene film of similar gauge, and it is believed that the stiffness will be sufficient for use in automatic packaging equipment. Nylon film may be sealed by high-frequency, impulse, or hot-bar heat sealers.

**Method of producing blown film utilizing a cooling air ring is covered by U. S. Patent No. 2,461,975, owned by Visking Corp.

Flat Film and Sheet

Flat film and sheet are made by using a slit die and extruding onto a steel roll. A diagram of the film operation is shown in Figure 7.

The die is designed to extrude the film at a 45° angle below the horizontal. The first cooling roll is brought under the die and within one or two inches of the die lips. It is important to locate the cooling roll in relation to the die lips so that the film is pulled straight from the die, and does not drag over the bottom or top lip.

(*Continued on page 480*)

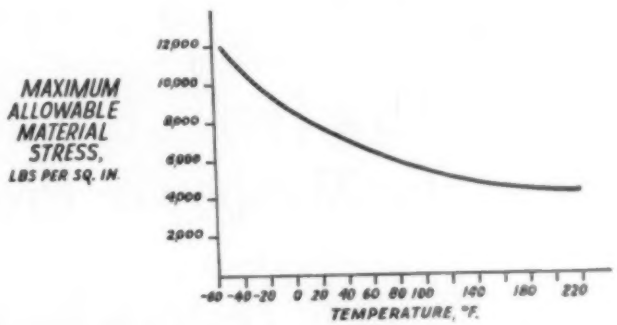

Fig. 5. Effect of temperature on maximum allowable material stress (from quick-burst tests) of Spencer nylon pipe at 23° C. moisture content.

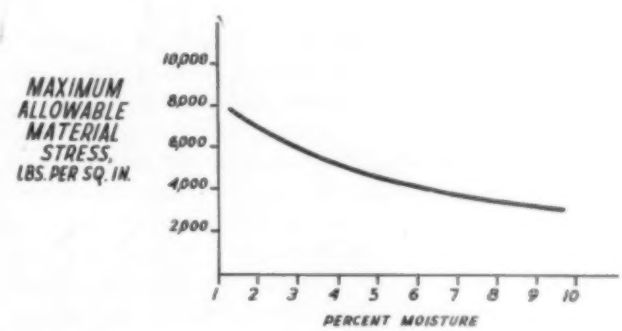

Fig. 6. Effect of moisture content on maximum allowable material stress (from quick-burst tests) of Spencer nylon pipe at 23° C.

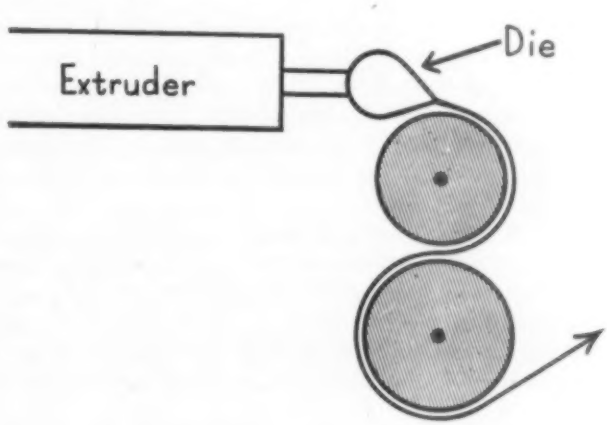

Fig. 7. Schematic drawing of film extrusion operation.

Scientific Manpower Problems

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THERE has been much discussion recently in the magazines and newspapers about the so-called acute scarcity of capable scientific men needed to staff the fast growing tempo of technical research and development programs being undertaken by our big industries, particularly in electronics, aviation, nucleonics, and chemistry. Every day in the big-city newspapers, we can see several pages of large "help wanted" advertisements for top-quality scientists and engineers, offering all sorts of splendid inducements. Most of these advertisers have military contracts or "grants-in-aid" for research programs. Such talent-searching costs are added to the end product, and eventually we all pay for them with our taxes.

Isn't it possible that many such advertisers have all the talent they need if more efficient use was made of all their workers We have all heard stories about many of our scientific men being required to use a lot of their valuable time in doing secondary chores that could be done by a well-chosen team of assistants.

We also have heard stories of how highly qualified and often gifted technicians seem to be excluded from the top ranks of scientific men; in some cases, only because they do not have B. S. degrees from our scientific universities. Many such technicians have been known to quit their job, not once but several times, in order to find an employer who will let them work to their fullest ability, pay them accordingly, and grant them a professional status of which they can be proud. It is no secret, either, that such near-scientists often come up with some very worthwhile, although unorthodox ideas that would be well worth testing.

As in the sports arena, our scientific world could profit by having a "second string" team to draw upon. Management might already have a "team of scientific men" right under their noses if they would only look diligently enough.

Another subject is the tendency for both technical and management men to underestimate the importance of "home work" in the constant study of all technical material available—trade and scientific magazines, and the many free technical bulletins coming from producers of materials and equipment in their field. Such extra reading is just as important in the business and scientific world, as it was in the early days of getting the school diploma. In these days of urgency, those that stay on top must keep on earning "diplomas" constantly, or fall behind.

It's not enough to "subscribe to" or just "glance over" these many scientific publications, but to actually read them and put their ideas to work, if possible. Oftentimes, a scientific fact, useful in another field, can be used in one's own work.

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Sawing and Machining Glass-Reinforced Plastics with Diamond-Coated Tools

The second in a series on current techniques and equipment for cutting and trimming of plastics.

IT has become increasingly clear that additional production at lower costs is the goal of all independent fabricators who depend on the large aircraft plants and electronics companies for the bulk of their work. Competition now demands close-tolerance work and the adoption of mass-production methods in order to turn out work on schedules that could not be met only a year ago. All this and make a profit, too! How this is being done by many of the forward-looking firms is described in this paper.

Most of the high-production runs and the large plastics sections have been let out to independent sub-contractors. Such parts as radomes and thick, heavy structural parts usually have been built by the plastics companies specializing in this field. Consequently, the main plants of the aircraft companies are not as familiar with all the techniques and tools as are the sub-contractors.

One of the major aircraft companies has been following a system of tool classification and procurement that prohibits the use of the most modern methods because production of any one part is not great enough to warrant expensive tools, and each tool purchased must be wholly charged off to the job project concerned. Although there is a multitude of projects, the production men must utilize the cheaper and more inefficient tools, and individual project costs skyrocket because of additional labor expenses.

The reinforced plastics industry is here to stay, as we all know. Some of the volume producers have set up individual diamond-coated tool cribs for all sawing and machining operations on glass-reinforced plastics. Regardless of whether the individual production job calls for six or 6,000 parts, if a tool of special size or shape will do the job faster and cheaper, that tool is provided. When the job is finished, the tool goes back into the tool crib and is available when another operation comes along which that special tool can handle very easily. Thus, the tool will not only pay for itself in a short time, but also many varied

The first article in this series was "Cutting and Trimming of Plastics with the Panel Saw," by R. W. Hendrick, published in the February issue, p. 105-7, 119.

work projects are completed and the tool remains in the crib ready for more work.

Since the introduction of diamond-coated steel tools for machining glass-reinforced plastics, many of the major aircraft manufacturers have instituted evaluation programs for all their previous methods and tools. These programs include not only the machinery, but also the cutting tools involved. Tests are being carried out to compare sharp-edged tools such as carbide-tipped saws, routers, and mills; grit wheels; burrs; and high-speed tools such as drills, hole saws, etc. Although their sub-contractors discarded sharp-edged tools in favor of diamond-coated tools for the past three years, these major companies are still in the introductory stage. In many instances, these companies have been using one or several diamond-coated tools for as long as one year or more, but have not informed their plants and plastics departments in other parts of the country.

In the small independent plants where the owners personally watch production methods and costs, a one-day production run is sufficient for a decision to change over to diamond-coated tools, even if it means buying new, high-speed equipment or re-working existing equipment to obtain the power, speed, and precision needed to take advantage of the tremendous savings available. The independent owner does not require a committee to institute evaluation programs, neither does he delegate the gathering of performance data to tooling engineers who are several echelons and departments below him. The latter is the case in the larger companies where reports covering several months of time-consuming investigations are referred to an overloaded upper-echelon individual, not thoroughly familiar with the characteristics of glass-reinforced plastics, for a decision.

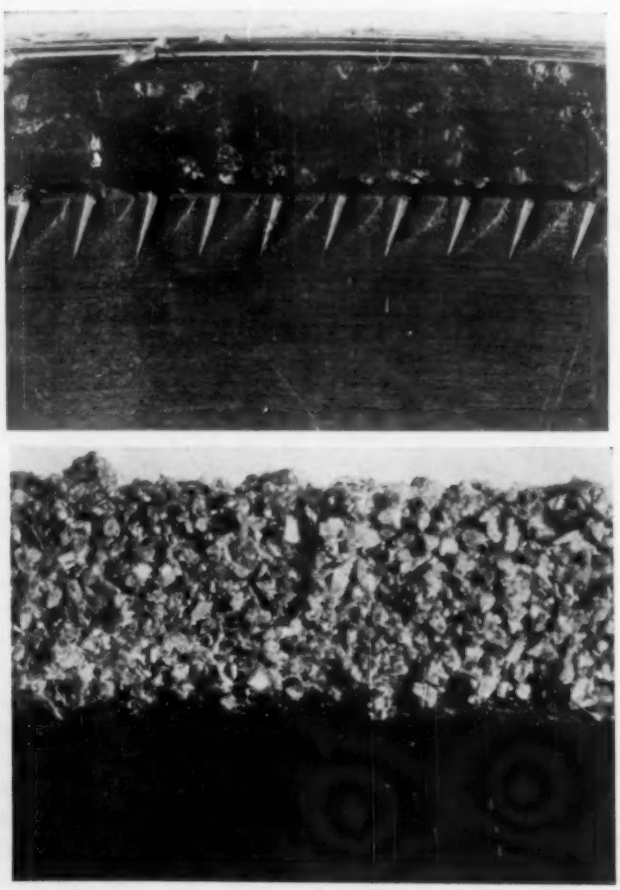


Fig. 1. Enlarged sectional views of diamond-coated saw blades show (upper photo) sparsely spaced diamonds of a conventional saw, and (lower photo) mass of diamond grits produced by Dia-Chrome process.

In the majority of cases, the foreman in charge of the actual production machines and tooling is considered incapable of judging tool efficiency. Yet, he is the man who must use the tools and, in any evaluation test, must operate the tools to their best advantage. His attitude, therefore, is one of indifference, resentfulness, and non-cooperation that is not conducive to efficiency and high morale. He was selected a foreman for his qualities of leadership and experience, yet management proceeds to nullify these assets by ignoring him. Production men cannot eliminate the value of theory and engineering knowledge, but neither should they overlook the value of experience.

Diamond-Coated Tools

Diamond-coated tools currently on the market have been manufactured by various processes for specific applications. Most industries are familiar with sintered powdered-metal and diamond tools, plastic- or resin-bonded diamond tools, vitrified bonded diamond tools, and pressed diamond-chip tools. Each of these types was developed to meet a specific need for certain types of materials. They have been on the market for many years, and were accepted before the glass-reinforced plastics industry expanded to the point where it needed something better than metal-working tools or existing diamond tools.

Since more than 90% of the cutting edge of a conventional diamond saw used to cut glass-reinforced plastics is of soft metal, it is imperative that it be flooded with water to keep the blade from over-heating. Figure 1 (Upper) is a view of an enlarged section of this type of saw, and clearly shows the sparsely-spaced diamonds. Since the cutting power of the tool depends on the amount of diamond surface, it is evident that this type of tool is limited in its cutting power and life.

Figure 1 (Lower) shows an enlarged section of the same-sized saw made by using the Dia-Chrome process to coat the edge with a homogeneous mass of diamond grit that produces a surface that is nearly 100% diamond. This surface does not require a water coolant because every grit cuts and removes its counterpart in size of material as it passes through the cut. Hence, there is no drag of bare metal to cause heat-producing friction. In addition, the life of the tool is increased greatly because of the abundance of diamonds.

The demand for specially-designed tools in all sizes and shapes to machine, drill, shape, plane, and saw glass-reinforced plastics is growing tremendously. The availability of diamond-coated, one-piece steel tools in any shape or size opens up an unlimited field for plastic part designs that were limited previously by existing tools not designed specifically for work in this field. While many difficult operations were accom-

plished with these conventional-type tools, excessive costs were a limiting factor in the sale and use of the parts produced.

There are many other types of hard plastics, such as phenolic reinforced with paper, cloth, and other materials, that are totally unsuited to cutting with diamond-coated tools because these plastics do not grind readily into a fine, dry dust. It is the presence in the plastic material of glass which, by its extreme abrasiveness, keeps the diamond surface clean. In fact, the ceramics, mica, asbestos, pure glass, tungsten-carbide, and the new ceramic-metallic materials all are ideal for this new advance in diamond-coated tools.

The greatest advantage that diamonds have over all other abrasive surfaces is that not only are they the hardest of all available materials, but also that, under normal working conditions, the diamond coating wears by fracture and breakage of the diamonds. This breakage of the diamonds takes place at infinite angles, and always leaves sharp edges or points to continue efficient cutting. As the breakage continues, the remaining portion of the grit becomes smaller and finer until it is used up completely and the steel left bare. When the rate of feed becomes so slow that it is no longer economical, the blade is sent back to the factory for re-coating. The steel blade blank can be re-coated again and again as long as it is in perfect concentricity and alignment.

The reinforced plastics industry is constantly designing new parts and shapes to replace metal parts in every field. Tremendous savings can be realized if specially-designed diamond-coated steel tools are provided for sawing and machining operations of unusual shapes and dimensions. A standard tool coated with 80-mesh diamond grit normally will be 0.001-0.005 inch oversize. The plastic part, on the other hand, usually has a dimensional tolerance of ±0.003-0.010 inch. Adding together the maximum minus tolerance of the part and the maximum oversize of the tool, a total of 0.015-inch is available for wear. When the finer-mesh grits are used (such as 180-mesh and 320-mesh), a maximum wearing range of 0.005-0.007 inch is available.

Aircraft Applications

How reinforced plastics are replacing structural metal parts in the modern airplane is exemplified by the propeller afterbody assembly designed and fabricated of glass-reinforced epoxy by Chetron Corp., of Los Angeles, Calif. The part was mounted on a revolving table and positioned on a Van Norman milling machine (used because it was the only unit in the plant large enough to handle the part).

The tool used was designed by Chetron and coated with 80-grit diamonds to the finished dimension. By slowly turning the part manually across the face of the grinding tool, four or five passes were needed to finish-grind the top and bottom part surfaces, as well as the curved faces of the part's six legs. Only 10 minutes were needed to complete the six legs, and on revolution of the part required approximately two minutes. If the spindle speed were to have been increased to 3,450 rpm., one pass on each leg would have sufficed.

This operation formerly was done with hand tools, using a fly-cutter. Some 45 minutes of time were required, and the required additional hand-sanding and filing finishing operations took another one-half hour or more, for a total time of 1½-2 hours as compared with 10 minutes for the diamond-coated tool. It is estimated that this tool will complete all production requirements for this part needed by the Lockheed Super-Constellation in the foreseeable future.

The Aerojet-General Corp., Azusa, Calif., manufacturer of JATO units, required a smooth, fracture-free cut on six-inch diameter, ¼-inch thick deflector tubes. This cut, shown in Figure 2, was set at a 60° angle, and the outer edges and point had to be cut clean and sharp, without any delamination. After trying other types of saws without success, they installed an 18-inch diameter, diamond-coated saw in an overhead machine. The saw blade revolved at a speed of 3,450 rpm. (17,250 surface feet per minute).

The jig or holding fixture was, in effect, a multi-angled miter box which permitted the operator to cut the tubes at various angles to suit the positioning of the JATO units in all custom installations. In addition to the tube-sawing operation, the diamond-coated blade also is used by the firm to saw flat reinforced-plastic sheets ranging in thickness from ¼-3 inches.

A difficult operation was solved by H. I. Thompson Fiber Glass Co., Inglewood, Calif., where various sizes of recesses had to be cut around the thick edge of four-foot diameter glass-reinforced plastic radomes. These recesses ranged from ½-1½ inches

(Photo courtesy of Aerjet-General Co.)

Fig. 2. Cutting reinforced-plastic deflector tubes for JATO units with an 18-inch diamond-coated saw blade.

in depth, and were of different shapes. A hand router (see Figure 3) turning at 18,000 rpm. was used with sufficient water to absorb the cutting dust and wash it away from the tool as fast as it was generated. The outline of the steel pattern and plate attached to the hand router controlled the shape and depth of the cut.

This tool was a two-inch diameter edge planer with a ¼-inch edge that was bottom-coated, as also was the ⅛-inch inside diameter of the recessed bottom. This permitted the tool to be plunged directly into the surface of the radome. By working the tool in all directions, all three surfaces of the planer ground away the material until the two steel plates met and the tool could go no further. The time required to cut each recess ranged from 6-10 minutes, depending on the size, and depth of the recess. One tool averaged 25 radomes, each having eight recessed sections, or a total of 200 recesses.

Polyester Planks

Another example of high production from a small tool is a two-inch diameter edge planer with ⅛-inch bottom edge used by Real Art Plastic Co., Los Angeles, Calif., in a precision surface grinder having a universal head attachment to cut glass cloth-reinforced polyester planks. The rough planks were 46 inches long, 11 inches wide, 1⅝ inches thick, and weighed 28 pounds each. The first step was the cutting off of two strips at a 30° angle by means of a 16-inch diamond-coated saw blade installed in an Oliver table saw with a tilt-top table. This operation removed eight pounds of material, and the resultant wedge-shaped chord was mounted on the surface grinder

Fig. 3 Diamond-coated edge planer used to cut recesses around edge of four-foot diameter, glass-reinforced plastic radome.

for final shaping and planing by a diamond-coated edge planer. Four ¼-inch holes in the top surface of the tool permitted dust to be removed by a suction head.

After the entire surface had been ground precisely, including two ¼-inch steps cut in the wide end, the same size tool with a 45° angle face was used to cut the steps at a 45° angle. The entire job was completed in approximately eight hours. One tool completed an average of 20 chords, or a total of 200 pounds of material ground off, before it required recoating. The company uses this particular design for several other heavy cutting operations and, over a period of two years, has found it to be the most economical and fastest method for removing large quantities of material.

One of the best examples of correct tool usage is the automatic edge planing machine (see Figure 4) built by the Aircraft Division, Hughes Tool Co., Culver City, Calif. This machine was designed around a ¾ by ¾-inch diamond-coated burr that has a ⅜-inch diameter shank and is 3⅞-inch in over-all length, using 80-grit diamonds. Both ends and two angular sides of the sheet plastic part are finished to a maximum tolerance of 0.010-inch, and the total peripheral part length is 29½-inches. The material is high heat-resistant, glass-reinforced phenolic, and each sheet is 0.040-inch thick. Each burr finishes approximately 500 parts before recoating is necessary. Since no adjustment is provided to compensate for wearing of the tool, the maximum tool wear cannot exceed 0.010-inch. (In this case, too, a double-suction head removes all cutting dust as it is generated).

Powered by hydraulic rams that follow the contour pattern, and turned by a compressed air router head at a speed of 17,000 rpm., these burrs have done a remarkable job. This is due primarily to the steady rate of feed, and the even degree of pressure maintained against the work. When a small tool like this is used in a hand tool, the resulting uneven pressure and rough usage can shorten the tool life.

Another machine, specifically built for high-production work by Hughes' Aircraft Division is the manually-operated cut-off saw for six-inch diameter radomes. This machine, (see Figure 5), designed around a four-inch diameter saw having a 0.120-inch thick edge and a ½-inch diameter shank, also uses an air router revolving at a speed of 20,000 rpm. This unit is mounted on a sliding ways, and a hand-operated crank on a threaded shaft is used to advance the saw into the work. The complete cycle takes about one minute, and the cut edge is smooth and of exact dimension.

The radome is placed on the head by hand, and centered by means of the telescopic sight mounted above the clamping device. When the part has been centered, the operator presses the valve button and an air ram lowers the clamp over the radome. The electric motor is started, and the head and clamping assembly rotated at approximately 100 rpm. by means of a gear-reduction box mounted directly under the head. The air router is turned on, and the saw assembly moved forward into cutting position. When the cut has been completed, the clamp is retracted

and a jet of air blown through the holes in the revolving head in order to eject the radome. The entire cycle takes about one minute, and the cut edge is smooth and of exact dimension. A vacuum-type dust collector used to remove cuttings is not shown in the photograph.

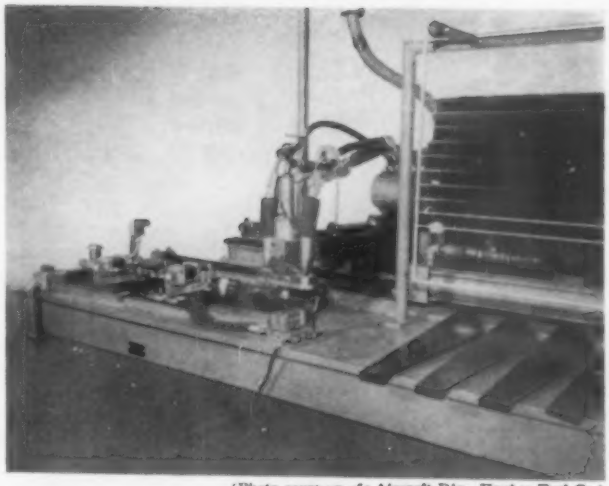
The cutting power of the new diamond coating is demonstrated by the fact that solid, 4¼-inch thick disks of Pyrex glass were sawed on a conventional bandsaw machine by the Northrop Aircraft Corp. optical laboratory, Pasadena, Calif. A piece of one-inch thick plywood was used to cover the steel table of the machine, and a garden hose for water coolant attached directly over the blade. A handful of ⅛-inch diameter ball bearings was dispersed on the table after the bearings were given a coating of heavy grease to prevent them from rolling off the table. The heavy glass disk was placed on the dispersed bearings so that friction from moving the work was practically eliminated.

The job consisted of sawing two 21-inch diameter disks into elliptical shapes. At the widest portion of the cut, 3½ inches of glass were removed, and this tapered into nothing at both ends of the ellipse. The operation was wholly manual, and the rate of feed was about 12 inches in 25 minutes. The total length of cut on each disk was 61 inches. The exact pattern desired was laid out on a 1/16-inch thick, clear plastic sheet coated with Dykem blue. The operator was able to follow the scribe line exactly, and very little final grinding was required in fact, not more than 0.020-inch had to be ground off in any one area.

One of the most difficult and expensive operations in the cutting of reinforced plastics is band sawing with conventional blades. Many shops have reported up to 15 blade breakages in one eight-hour shift, and the resultant loss of time is many times greater than the actual cost of the blades. Even when the blade is new and sharp, the operator cannot follow a scribe line within ⅛-inch, but will vary from this line by as much as ¼-inch. Finish grinding of the excess material down to the scribe line is required, and the additional time needed for this operation costs as much as the original sawing, even if done mechanically. Where it is necessary to do additional hand finishing with files and emery cloth, this will add even more cost.

A diamond-coated handsaw blade, 0.080-inch thick and ⅜-inch wide, is used to cut through a four-inch thick piece of glass-reinforced melamine, holding a small radius on the cut. In Figure 6, this 19-foot 10-inch long blade is shown cutting ½-inch thick glass-reinforced melamine, and following the scribe line without any wavering.

This blade was run at a speed of 3,000 surface feet per minute, and under just enough tension to prevent it from slipping on the wheels. The rollers and guides, however, should not be more than two inches above the work to prevent the blade from twisting and setting up strains that could lead eventually to breakage. As with any other new tool, the operator must learn how to feed the various thicknesses of materials into the cutting edge so as to obtain maximum production from each type of tool.

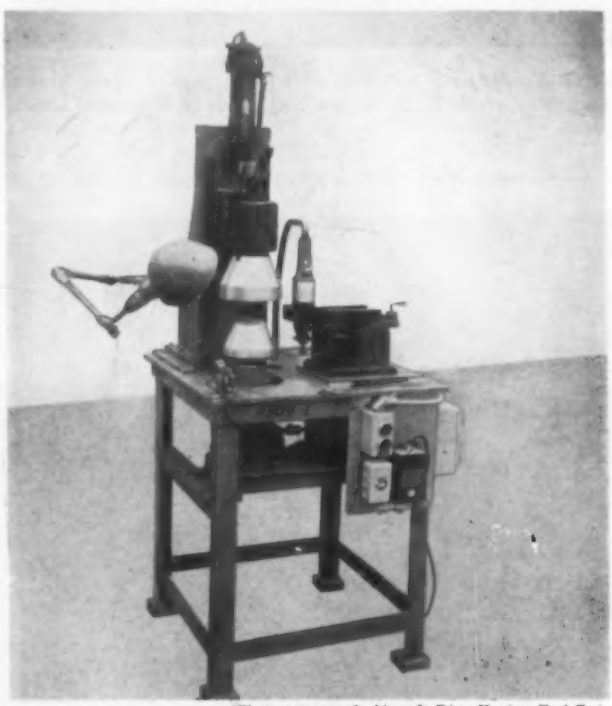


(Photo courtesy of: Aircraft Div., Hughes Tool Co.)

Fig. 4. Automatic edge planing machine designed around diamond-coated burr is used to finish glass-reinforced phenolic sheets.

Electronic Applications

High-production runs of identical parts, such as are required by the electronics industry where the usual dimensional tolerance is 0.001-0.002 inch, now can be produced without elaborate set-ups and expensive finishing costs. Etched circuit boards are typical of this type of operation, as are glass-silicone tube cores, melamine insulators for armatures, and many other parts suited to mass production. In a simple, inexpensive set-up for producing 4¼ by 4¾ inch boards, a 10 by 0.080-inch diamond-coated saw is used to cut the original 18 by 36-inch sheets which are bolted together at one edge. Five copper-clad epoxy sheets, 1/16-inch thick, are sawed at one time, and the re-



(Photo courtesy of: Aircraft Div., Hughes Tool Co.)

Fig. 5. Cut-off saw for six-inch diameter, reinforced-plastic radomes is designed around diamond-coated saw blade.

(Photo courtesy of: Formica Corp.)

Fig. 6. Diamond-coated bandsaw blade saws one-half inch thick, glass-reinforced melamine sheet.

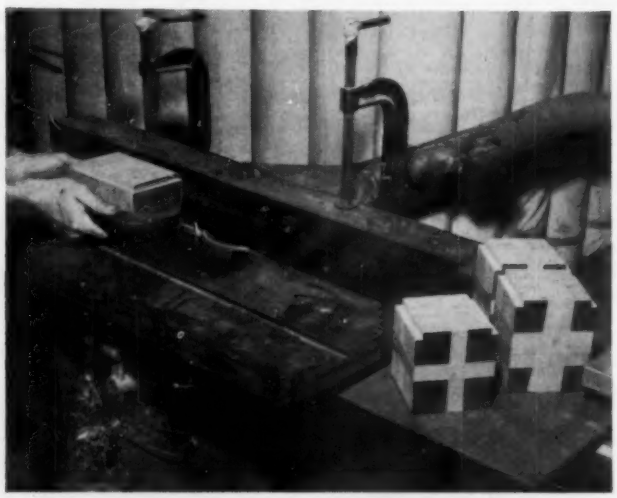


Fig. 7. Simultaneous notching of 80 copper-clad epoxy sheets clamped into solid block, using a diamond-coated grinding wheel.

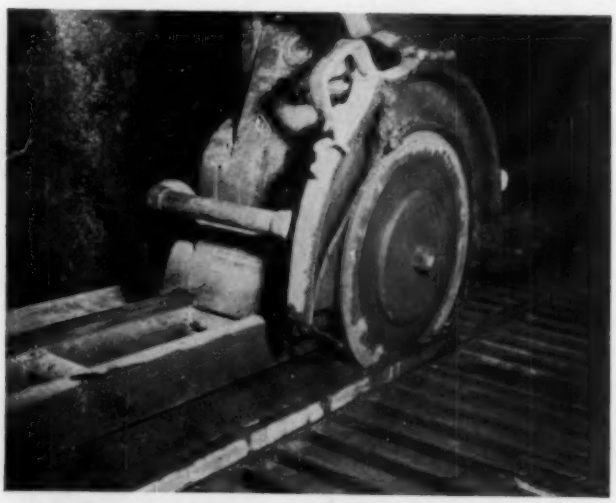


Fig. 8. Diamond-coated saw being used to cut 1¼-inch thick panels of Colorlith.

sulting sawed edges are finished and meet the desired dimensions.

Then, 80 boards are set up into a solid block that is aligned, straightened, and held together with a "C" clamp (see Figure 7.) A specially-designed, five-inch diameter, diamond-coated grinding wheel having a ⅜-inch edge and ⅛-inch return coating on both sides is mounted on a router table turning at 3,450 rpm. and powered by a one-hp. motor. Each circuit board has either two or four corner notches, depending on the circuit lay-out; approximately one-half of the first order of 20,000 boards required four corner notches, and the notch sizes were 0.308 by 0.291-inch and 0.228 by 0.190-inch. The entire block of 80 boards was run through the grinding wheel in about 10 seconds. Although a total of 60,000 notches was made, the grinding wheel showed practically no wear. Another contract order for the same quantity of boards is expected, and will be completed with the same tools.

The company reported that only 50 of the first 13,000 boards delivered were rejected for being oversize. These were reworked subsequently and accepted. No rejections because of improper notch dimensions were received for the 60,000 total notches.

A sample order previously received by this company was let out under sub-contract at a price of 4¢ per notch, the cheapest price obtainable using the conventional sharp-edged milling tools. The milling operation required at least three passes to obtain the required depth of cut, and only 15 boards could be milled at one time. The tremendous savings realized by using diamond-coated tools is obvious.

Non-Plastic Applications

There are many other abrasive materials, such as Johns-Manville's Colorlith, that may not be classed as "plastics," but are very hard and brittle. Figure 8 shows a 16-inch diamond-coated saw being used by Weber Showcase & Fixture Co., Los Angeles, Calif., to cut 1¼-inch thick panels of Colorlith. The saw is powered by a 10-hp. motor at 3,450 rpm. Colorlith material requires a free flow of cooling water directed to both the front and back of the blade. In addition to the silica, cement, and asbestos in the material, there also is an inert coloring agent which has a tendency to glaze over the diamond-coated blade surface if too much heat is generated; hence, the double coolant stream.

After a period of six months, the blade has sawed more than 5,500 linear feet of Colorlith. At the end of this time period, the blade still cut, but at a rate too slow to warrant continued use. This blade was returned for complete re-coating, then sent back into production.

Transite and other materials were cut with this blade when the need for panel sawing arose.

In addition to the long-life feature, the most important quality inherent in this type of coated blade is the smoothness of cut it produces. Even new, perfectly sharpened toothed saws leave a chipped cut edge, and a slightly dulled saw blade will produce an unacceptable edge and finish on the cut.

(*Continued on page 480*)

Developments in Polyurethanes, Unsaturated Polyesters, Polyvinyl Chloride, and Acrylonitrile Copolymer Blends.

WILLIAM CUMMING, *Head of Kralastic Research, and*
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Polyurethanes

STEPPED up production of diisocyanates in 1956 made possible the initial stages of a wide-ranging, and potentially large, market development for polyurethane materials. This market has been estimated at 100 million pounds in 1960 (1)*. It includes such diverse applications as foams (flexible and rigid), rubbers, surface-coatings, adhesives and plastics.

AGING. Flexible foams have received the greatest portion of the development effort so far. The problem of humid aging of these materials has been attacked from the standpoint of the catalyst. Winkler (2) assumes that the catalyst left in a finished foam is capable of accelerating depolymerization reactions occurring in humid atmospheres. His study of foam stability as a function of catalyst type (tertiary amine, n-alkylmorpholine, tertiary amino-alcohol, tertiary aminophenol or tertiary esteramine) shows that the higher the volatility of the catalyst, the better aging the foam. Winkler synthesized the beta-diethylaminoethyl ester of ethylenediamine tetraacetic acid and found it was a good foam catalyst, giving foam having good 14-day humid aging. He suggests that catalyst immobilization through reaction with the isocyanate is responsible.

PROPERTIES. Kenline and Hirschbeck (3) give the effects of polyester, diisocyanate, water content, and surfactant variations on the properties (density, softening point, tensile strength, and compressive strength) of a rigid foam. The thermal insulating qualities of rigid foams are discussed by Harrington (4). He points out the backward step involved in making slab stock polyurethane foam in view of its foam-in-place adaptability and good adhesion to cavity surfaces. Variations in tensile strength, compression, and recovery from 50% compression with density are given in this paper.

Harrington also discusses resilient foams from the standpoint of compression-deflection relations, load deflection, and low temperature properties (4). Kenline and Hirschbeck (3) consider other uses of polyurethane materials. Rubber properties are related to polyester composition. Hardness of surface coatings is seen to vary with the hydroxyl/isocyanate ratio and aromatic content of the compsition. Adhesives are discussed from the standpoint of bonding temperature. Considerable information on foam formulations, procedures, testing, and properties has been assembled (5).

TESTING. Tentative specifications and test methods have been published (6) and subsequently withdrawn. Einhorn and Brucksch (7) have described a convenient jig for preparing test samples of foams.

*Numbers in parenthesis refer to bibliography at end of article.

MISCELLANEOUS. A study of how substituent groups on the nucleus of an aromatic isocyanate (including another isocyanate or a urethane group) effects its reactivity in urethane formation has been carried out (8). The results should be useful in selecting the proper diisocyanate for specific polyurethane properties. Properties of Adiprene B, a polyether glycol polyurethane elastomer, are described, and details given on its cure with added diisocyanate (9).

Unsaturated Polyesters

Growth in the polyester segment of the reinforced plastic industry in 1956 was paced by the expanding use of premix molding compounds, and by increased usage in boat construction. Production techniques, resins, and reinforcing materials for premixes are described (10). A new technique for the lay-up of a 42-foot boat over conventional boat forms and thin veneer demonstrates the adaptability of polyester to boat construction (11).

A resin designed specifically for boat covering was introduced. It has good impact properties, fast cure, thixotropic properties, water-whitening resistance, good adhesion, and cures tack-free (12). For boat construction, a recently developed resin allows 10% or more increase in production rates, owing to its faster cure (13).

The use of reinforced plastics in aircraft construction is discussed by Cutler (14), with the conclusion that better resins, reinforcements, finishes, and a higher strength/weight ratio are required if use in critical aircraft applications is to match the use in non-critical areas. Adhesive formulations for reinforced plastics are dealt with by Been and Grover (15), particularly with regard to sandwich construction. Protection of concrete pipe against crushing loads and soil attack by a glass roving-polyester sheath is a new application in Britain (16).

REINFORCEMENTS. Bjorksten (17) has written a thought-provoking article on non-glass reinforcements. He makes the point that many natural and synthetic fibers should be useful, provided pretreatments and finishes are developed for them and the resin is tailored to the physical properties of the particular fiber. Rosato has dealt with asbestos reinforcement in detail (18).

A study of available core materials for increasing stiffness in reinforced plastic structures has led to the selection of balsa wood as the most suitable material (19). Goldfein (20) has studied prestressing in glass-polyester systems.

PROPERTIES. An interim report on a long-term study of stress-rupture and creep characteristics of glass-reinforced plastic laminates has been published (21). Results of a stress-rupture test in an air or water environment also are available (22). Measurements of specific heat, thermal conductivity, and thermal expansion by O'Brien, Oglesby and Covington (23) should also be useful to the design engineer. Dietz and co-workers have followed polyester cure using ultrasonic waves (24). The flame and arc resistances of polyester laminates, as influenced by fillers and chlorine-content of the resin, were studied by Allen (25).

MISCELLANEOUS. Material and environmental conditions for bulk storage of polyester resins are described (26). Rees (27) has given refinements on a continuous resin injection system for glass-reinforced moldings. Lunn Laminate's technique for analyzing a contract bid is described by Nerzig (28). Also announced were a matched metal die and premix molding resin designed for rapid molding cycles (29), and a craze-resistant, low-shrinkage resin (30).

Polyvinyl Chloride

Technical developments in polyvinyl chloride during 1956 involved all use patterns, but was predominant, as might be expected, in the area where large future growth is expected.

PLASTICIZERS. Wartman and Frissell discuss resin-plasticizer interactions using the Flory-Rehner expression and the Flory-Huggins value for solvent-resin interactions (31). They also deal with the mechanism of plasticizer loss under a variety of experimental conditions. Frissell (32) reports on correlations between activated carbon milling, and room-temperature aging losses, as well as with the vapor pressure of plasticizers at 70° C. Use of bisphenol A in oxo-ester plasticizers is found to improve their stability (33).

Industrial applications of plastisols are discussed by Norum (34). An investigation of surfactants for lowering plastisol viscosity reveals that polyethylene glycol 200 monoricinoleate is more effective than presently used materials (35). A method is described of continuously measuring the apparent viscosity of a plastisol as its temperature is varied (36). Spread coating and fabric coating techniques are thoroughly reviewed in two papers (37, 38).

Applications of rheology to plastisol applications are discussed by Werner (39).

FILM AND SHEET. The contributions of the resin to fish eye problems are discussed by Rector (40). British practice in blow extrusion of film is reviewed (41). Jukich described the use of roll bending in the gauge control of film and sheet (42).

FOAM AND SPONGE. Chemical blowing is discussed by Arnold (43). The Foam King mechanical process is dealt with in another paper (44). A British report on the use of the Elastomer Chemical Corp. process notes the use of high-frequency curing to give two-inch thick slab at 400 lbs./hour (45). The properties of vinyl foams and their relation to design problems are covered by Wisotzsky (46).

MISCELLANEOUS. A paper on injection molded PVC dry blends points out the small inventory advantage of this form over pellets (47). A simple measurement of volume resistivity, which requires only a small sample, and correlates well with insulation resistance of insulated wire is given by Balmer and Conyne (48). Sully treats the problem of electrostatic charges on polyvinyl chloride (49).

Acrylonitrile Copolymer Blends

The superior toughness and chemical resistance

of rubber-modified styrene-acrylonitrile copolymer resins have brought them into expanded use during 1956. Elliott (50) has treated the use of these materials in plastic pipe, including the extrusion process, molding of fittings, aging characeteristics, and long-term effective tensile. Retention of physical properties (Izod impact, flexural deflection, flexural strength, and flexural modulus) of these materials both at 160 F. and during outdoor exposure has been studied (51). They are included in the list of plastic materials found suitable for potable water by the National Sanitation Foundation (52).

Steiner (53) has reviewed the applications of acrylonitrile copolymer blends as structural materials, and gives data on their resistance to corrosive gases and to chemicals in general. The mechanical properties and chemical resistance of a styrene-acrylonitrile-butadiene thermoplastic have been presented (54).

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Pyrotex Asbestos–Reinforced Plastics

A discussion of Pyrotex asbestos products and their applications in the reinforced plastics industry.

ASBESTOS reinforcements are available in a variety of forms such as felt, mats, papers, asbestos molding compounds, prepared asbestos fibers, and cloth or yarn which provide unique properties including stiffness, heat resistance, chemical resistance, and insulation. This article will specifically describe asbestos-reinforced plastics that possess high strength and modulus of elasticity properties at room and elevated temperatures. These reinforcements are identified as Pyrotex felts and Pyrotex mats. Sheet materials approximately 10 mils in thickness are referred to as "felts", while sheet materials thicker than 10 mils are referred to as "mats".

The type of asbestos used in Pyrotex felts and mats is Chrysotile. Felts and mats are available with Chrysotile fibers both alone and in combinations with cotton, rayon, or glass fibers. When a combination of fibers is used, lower mechanical properties are generally obtained. The principal purpose for combining fibers is to permit products having a variation in properties that will be in direct proportion to their cost. The all-Chrysotile felt or mat makes available to industry plastics having exceptionally high modulus of elasticity values. Values ranging from 5-6 x 10^6 psi. in cured laminate can be obtained.

Chrysotile is superior to all other asbestos varieties for general industrial purposes, and accounts for about 95% of the world's production of this mineral. Chrysotile is found in veins in the base serpentine rock. Mechanical methods are used to separate the asbestos veins from the rock and, in turn, to separate the individual asbestos fibers. The most extensive Chrysotile asbestos mines are located in Canada and South Africa, and the Canadian mines are the sources for Pyrotex products.

Chrysotile is a hydrated silicate of magnesium having a composition represented by the chemical formula $3MgO.2SiO_2.2H_2O$. A more accurate representation would be $Mg_6Si_4O_{11}(OH)_6.H_2O$, since this indicates the number of atoms and their arrangement in the chrysotile lattice. Four of these molecules comprise a crystal unit cell. A characteristic of this structure is the double Si_4O_{11} chains running the length of the fiber. In these chains, each silicone atom is surrounded by four oxygen atoms in the form of a tetrahedron, so disposed that two of the oxygen atoms are shared by adjacent tetrahedra to form an endless chain. The magnesium atoms and hydroxyl groups serve as lateral bonds for the chain structure.

When the crystal orientation is good so that the Si_4O_{11} chains are lined up parallel to the fiber axis, the fibers are strong, soft and silky; when the orientation is poor, the fibers are harsh and brittle. Asbestos can be subdivided into fibers so fine that they are revealed only by the electron microscope. The finest of all fibers is found in Chrysotile, whose fibers are

1/50-micron in diameter.

The commercial value of asbestos depends largely on two physical characteristics; its unique fibrous structure, and its mineral nature. The fibrous structure permits it to be separated into filaments or fibers, many of which possess high tensile modulus of elasticity (25×10^6 psi.) and high tensile strength (in the order of 400,000 psi.). These properties enable the asbestos-reinforced plastics to have high mechanical properties. Its mineral nature causes asbestos to be resistant to heat, moisture, and corrosion. These particular properties vary considerably among the different types of asbestos, which include Chrysotile, Crocidolite, Amosite, Anthophyllite, and Tremolite. When Chrysotile is heated to about 900° F., a portion of the water of crystallization is removed from the crystal structure; approximately 1200° F., the hydroxyl (OH) radicals are removed from the crystal lattice; and at 1490° F., the crystal structure changes from that of serpentine to the olivine structure.

Properties of Asbestos

When asbestos is combined with various resins, the behavior of the combination cannot be directly related to that of asbestos alone. For example, an asbestos-phenolic laminate subjected to 5000° F. for a few seconds will retain its mechanical strength properties, whereas asbestos alone would retain very little of its strength properties. However, the fact that asbestos alone can be subjected to temperatures above 2500° F. without complete decomposition or melting enables asbestos-reinforced plastics made from heat-resistant resins to retain a good portion of their strength at elevated temperatures.

The properties of Chrysotile fibers which determine their usefulness in products are length, strength, toughness, flexibility, and freedom from impurities. Some Chrysotile fibers several inches in length have been found, but commercial fibers range downward from about ¾-inch in length. Chrysotile fibers having optimum physical properties are available in Canadian deposits, and are used in Pyrotex products.

The pertinent properties of Chrysotile fibers are as follows:

Specific gravity	2.4-2.6 (average, 2.5)
Refractive index	1.05-1.55
Color range	green, gray, amber to white.
Fusion point	2770° F.

Pyrotex products are composed of mechanically-opened asbestos fibers that have been processed through carding machines which arrange the fibers in a tenuous web. The carding process is a basic step in the manufacture of practically all asbestos and cotton textiles. A most important consideration is the fact that all Pyrotex products are made from spinning grades of asbestos fibers; the grades utilized range from No. 1 crude to No. 3R.

Since the end-uses of asbestos fibers are governed primarily by their length, an important step is the careful and accurate grading of fibers at the mill. The "Quebec Asbestos Producers Assoc. Screen Test", commonly known as the "Shaker Box Test," is the standard method of grading Canadian Chrysotile fibers according to their length.

Table 1. Standard Classifications of Canadian Chrysotile Fibers (spinning grades).

Group	Designation Grade	Fiber Length, In.
Group No. 1	Crude No. 1	¾ and longer
Group No. 2	Crude No. 2	⅜-¾"
Group No. 3	Spinning Fibers (milled)	Guaranteed Minimum Shipping Test:
	3F	7-7-1½=½
	3K	4-7-4-1
	3R	2-8-4-2
	3T	1-9-4-2
	3Z	0-8-6-2

The machine used consists of three rectangular screens held in frames one above the other. The top screen is the coarsest, the middle screen is the intermediate size, and the bottom screen is the finest. A box for collecting fibers that pass through the screens is placed under the bottom screen. To conduct the test, 16 ounces of fiber are placed on the top screen, and the nest of screens is shaken at a fixed rate for a prescribed period of time. The fiber grade is determind on the basis of the ounces remaining on each of the screens and depositing in the collecting box. Thus, if two ounces remain on the top screen, eight ounces on the intermediate screen, four ounces on the bottom screen, and two ounces fall into the box, the fiber is known as 2-8-4-2.

The standard classifications of spinning grade Chrysotile fibers are given in Table 1. Canadian Chrysotile also is produced in shorter milled fibers, designated as grades Nos. 4-9, inclusive. These fibers are adapted to numerous commercial uses, but are not of sufficient length for processing into Pyrotex products. Asbestos shorts and floats are designations used for grade No. 7 asbestos. Pyrotex products stand apart from commercially available asbestos paper products, since they only use grades No. 1 to 3, inclusive. Asbestos papers, although manufactured in many grades, are generally produced from very short asbestos fibers, identified as group No. 5 fibers.

Pyrotex Products

Felts and Mats

Pyrotex products are manufactured currently in

Table 2. Standard Pyrotex Felts.

	Style 9526RB5	Style 9529RB5	Style 9517RB5
Thickness (based on height of 10 plies), inches ±10%	0.010	0.010	0.010
Weight per 100 sq. ft., lbs. (±5%)	2.0	2.1	1.8
A.S.T.M. Grade (D375-52)	AAAA	AAAA	Und.
Asbestos fiber, % min.	99	99	80
Organic content, % max.	1	1	20
Glass cloth reinforcement, Nom. % of total Wt.	0	50	0

Table 3. Pyrotex Prepeg Mats

R/M Style*	Approx. Wt., Oz. Oz./Sq. Ft.	Approx. Thickness of Laminate Cured at 400 Psi., In.
9526D2	2½	1/64
9526D2	5	1/32
9526D2	10	1/16

*The suffixes D2 and D1 identify the prepreg as being made with phenolic resin having a special resin binder RB4. This resin binder is available only with the prepregs. At present, RB5 felts should be used by resin processors to obtain the high physical properties.

seven standard specifications, and wide modification of these specifications is possible and practical for individual applications. The two basic Pyrotex felts presently being used by the reinforced plastics industry, are identified as styles 9526 and 9517. Table 2 gives a description of these styles. Binder RB5 is used with these felts. While felts are available with approximately 3% by weight of binders designed for specific resin applications, recent evaluation programs have shown the RB5 binder to be suitable for use with different resins (phenolic, epoxy, silicone, etc.).

The ability of the felts to wet satisfactorily with resins and retain their wet strength is illustrated by the fact that they can be used in continuous laminating processes, and run through vertical drying towers when manufacturing prepregs. Felts with binders can be sent unsupported through 60-foot vertical towers.

Regular production runs are made of Pyrotex mat Style 9526D2. Most of the work to date, insofar as mats are concerned, has been with phenolic prepregs. Mats without laminating resin are also available and are presently identified as Pyrotex mat Styles, LS 9186NS, LS-9186RB5, LS-9187NS, and LS-9187RB5. These mats can be made in various weights up to six ounces per square foot. At present, a standard weight is two ounces per square foot. The LS-9186 series is designed specifically for applications where all-asbestos reinforcement is desired, such as in the field of chemical resistance and thermal insulation at elevated temperatures.

Felts are available in continuous sheets. The maximum width of rolls is 50 inches, and maximum weight of the individual rolls is 150 pounds. The presently available mat size is approximately 4 feet square, and development work to make larger sheets is in process. An arrow on the sheet material indicates the high-strength direction. The bulk factor of felts or mats is approximately 3:1 when the curing pressure used is 400-500 psi., and 3:2 when the curing pressure is 10-50 psi.

In parallel layups using Pyrotex felts or mats, the physical properties are in the ratio of 3:2 when going from the longitudinal to the transverse direction (the longitudinal direction is the machine direction). These products can be oriented in various patterns to produce laminates having varying directional properties. To obtain an isotropic sheet (whose properties in the plain of the sheet are the same in all directions), the felts need only be layed up at right angles to each other.

To date, the majority of work involving Pyrotex felts and mats has been with phenolic laminating resins. Available prepregs using phenolic resins are listed in Table 3.

Prepreg Mats

Prepreg mats can be made in any weight up to 10 ounces per square foot, and standard weights are 2½, five, and 10 ounces per square foot. When pressed at 400 psi., the 10-ounce material cures to a thickness of approximately 1/16-inch; the five-ounce material to 1/32-inch; and the 2½-ounce material to 1/64-inch thickness. The uncured sheets actually weigh slightly more per square foot after pressing. A solid laminate with a specific gravity of 1.7-1.85 weighs 8-9 ounces per square foot each for 1/16-inch in thickness.

Plastics Applications

Pyrotex-Phenolic Laminates

Physical properties of Pyrotex felt and mat-phenolic laminates are given in Table 4. Tests were conducted over a range from room temperature to 1,000° F.

Table 4. Properties of Pyrotex-Phenolic Resin Laminates.*

	R/M Styles 9526D1 Felt 9526D2 Mat**	R/M Style 9517D1 Felt
Resin Content, % by wt.	25-30	25-30
Volatility, %	5-10	5-10
Flow, %	4-8	—
Press-cure cycle (1/8-in. laminate):		
Pressure, psi.	400	400
Temperature, °F.	300	300
Time, hrs.	½	½
Post-cure cycle, hrs./°F.	4/300	4/300
	8/350	8/350
	8/400	8/400
Specific gravity	1.8	1.8
Properties at room temp.:		
Flex. mod. of elasticity, x10⁶ psi.	5.0-6.0	2.8
Ult. flex. strength, psi.	50,000-55,000	35,000
Tensile mod. of elasticity, x10⁶ psi.	5.0-6.0	3.5
Ult. tens. strength, psi.	45,000-55,000	24,000
%retention of properties after 30-day immersion in water:		
Flex. modulus	90-100	90-100
Ult. flex. strength	90-100	90-100
Ult. tensile strength	80-100	90-100
At 300° F. after 200 hrs. at 300° F.:		
Ult. flex. strength	85-90	—
Init. flex. modulus	85-90	—
At 500° F. after 100 hrs. at 500° F.:		
Ult. flex. strength	68-78	—
Init. flex. modulus	80-90	—
At 500° F. after 200 hrs. at 500° F.:		
Ult. flex. strengh	52-60	—
Init. flex. modulus	68-75	—
At 700° F. after 5 hrs. at 700° F.:		
Ult. flex. strength	45-50	—
Init. flex. modulus	48-52	—
At 1,000° F. after ½-hr. at 1,000° F.:		
Ult. tensile strength	20-25	—
Init. tensile modulus	35-38	—

*Longitudinal test data on parallel lay-up, approx. 40 plies for 9526D1 and 9517D1, and two plies for 9526D2 (eight oz./sq. ft.)
**Mat weights up to eight oz./sq. ft.

for the 9526 series. The test methods used for obtaining the data were in accordance with A. S. T. M. and the methods given in Federal Specification L-P-406b. Tests conducted at elevated temperatures were run at the test temperatures immediately after exposure of the specimens for the indicated periods of time. The test apparatus is shown in Figure 1.

As shown in Table 4, asbestos-phenolic laminates can be used at elevated temperatures. Parts have withstood temperatures of 2500° F. for 60 seconds, and 3500° F. for 6-10 seconds. Parts requiring low strength have been used after continuous exposure at 300° F. for periods of at least one year. Where thermal insulation was of prime consideration, these products have been subjected to 5,000° F. for short periods. These products are useful where dimensional stability of parts is required. Laminates and molded products have been subjected to temperatures of 300-350° F. in dry or wet steam with relatively no changes in dimensions or strength.

To develop the maximum strengths reported, the test parts were post-cured at different cycles of time and temperature, ranging from 1-5 days and 250-500° F. The time and temperature of post-curing depend on the part's thickness and shape. If blisters or delamination occurs during the post-cure, increased curing time at lower temperatures is recommended. Post-curing, however, need not be conducted with parts in the press mold. For applications where initial strength does not have to meet maximum properties and it is desired to subject parts to 300° F. for long periods of time, post-curing is not recommended.

The prepreg mats can be cut with standard equipment, such as shears, clicker dies, paper cutters, scissors, etc. The thicker mats can be cut with a linoleum knife or with automatic electric shears similar in type to those used to cut thin sheet metal. It is important to keep cutting edges clean during this operation.

The physical properties of laminates are largely dependent on the type of mold used, the molding pressure, and the asbestos:resin ratio. The flow characteristics of the resin contained in treated felts or mats should be established so as to coincide with the molding or laminating pressure and technique which will be employed. Press and post-curing cycles are given in Table 4. Resin flow of standard felt Style 9526D1 and mat Style 9526D2 (any weight) is in the range of 4-8%, by weight.

Table 5. Properties of Pyrotex Felts-Silicone Resin Laminates*

	R/M Felts 9526RB5, 9526NS
No. of plies	Approx. 30
Laminate thickness, in.	1/8
Specific gravity	1.6-1.7
Silicone resin content, % by wt.	50-55
Room temp. properties:	
Ult. flex. strength, psi.	30,000-35,000
Flex. modulus, x10^6 psi.	2.5-3.0
Ult. tensile strength, psi.	28,000-32,000
Tensile modulus, x10^6 psi.	2.2-2.8
Properties at 500° F. after 1/8-hr. at 500° F.:	
Ult. flex. strength, psi.	16,000-22,000
Flex. modulus, x10^6 psi.	2.2-2.6

*Longitudinal test data on parallel lay-ups cured at 300 psi. pressure and 340° F. for 1/2-hour. Post-cure cycles, in hrs./°F., were 16/200, 2/250, 2/300, 2/450, and 40/500.

Pyrotex Molding Compounds

For certain applications, the above Pyrotex sheet materials require the use of a filler material to handle non-uniform part cross-sections. Pyrotex-phenolic resin molding compounds are available which can be used either alone or in conjunction with the sheet materials.

R/M Styles LS-9184 and LS-9240 are asbestos-filled, high heat-resistant phenolic molding compounds. Style LS-9184 contains extra-long staple asbestos fibers, while Style LS-9240 contains a minimum of 80% spinning fibers and 20% organic carrier fibers. The bulk factor is 8-10:1. Another R/M molding compound is Style LS-9178, which is basically similar to LS-9184 with the exception of asbestos binder.

Pyrotex-Silicone Laminates

Felts with RB5 binder are a recent development

(*Continued on page 480*)

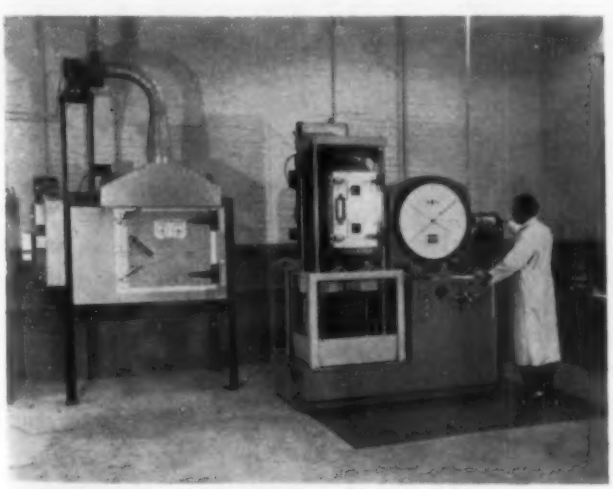

Fig. 1. Apparatus used to conduct high-temperature tensile tests.

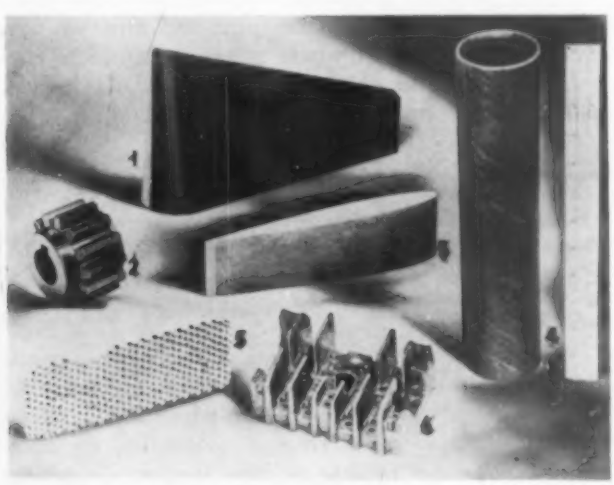

Fig. 2. Some typical parts molded of asbestos-reinforced plastics.

Pressure Control for Injection Molding Machines

(*Continued from page 462*)

tem will control the following six variables either completely or in part: granular feed; interrupted molding cycle; changes in material formulation; changes in plastic temperature; changes in cycle timing; and changes in mold temperatures.

The degree of control of these variables will depend on the molding situation, placement of the gauge, and the control system used.

In general, however this type of control system will give better uniformity of quality and piece weight. Someday, perhaps, someone will design a molding machine using this control system that will give better and more uniform parts with a much simpler system of control switches and knobs on the machine.

—THE END

Extrusion of Nylon 6

(*Continued from page 465*)

The temperature used on a 2½-inch extruder at a rate of forty pounds per hour are:

Rear zone	500° F.
Middle zone	525° F.
Front zone	525° F.
Die	480° F.

The first cooling roll should be controlled at a temperature of 130-140° F., and the second roll at 60-70° F. Nylon film made by this technique is exceptionally clear, even in gauges of 5-6 mils. Heavier gauges for sheet material are made in the same manner.

The tensile and tear properties of blown and flat nylon film are compared in Table 3. The blown film has higher ultimate tensile strength and yield point. The elongation is comparable for both films. The flat film has greater tear strength, and is a clearer and tougher film because of its amorphous nature.

Summary

Nylon 6-type film and pipe are new products, and markets must be developed for them. Nylon is an expensive raw material for pipe and film, but its excellent physical properties will largely compensate for the added cost. In nylon pipe and film, we have products that will withstand steam sterilization temperature, be resistant to petroleum oil and greases, and have sufficient toughness to insure long life.

—THE END

Sawing and Machining Glass-Reinforced Plastics with Diamond-Coated Tools

(*Continued from page 472*)

Conclusions

With the advent of automation in the sawing and machining of electronic plastic parts in great quantities, the use of conventional sharp-edged tools nullifies the advantage of uninterrupted production by automatic equipment because of the frequent stoppages required to replace worn and dulled tools, and the frequent check needed to inspect the work for burring and chipping because of dull tools. With diamond-coated tools, however, wear is negligible throughout the major service life of the tool, and the smoothest cut finishes are obtained when the tool is nearing the worn-out (or maximum dimensional tolerance) stage.

—THE END

Pyrotex Asbestos-Reinforced Plastics

(*Continued from page 479*)

which was instigated because of the high-temperature test data recorded on laminates using Pyrotex felt Style 9526NS and Dow Corning DC-2106 silicone resin. Since felt Style 9526NS could not be used in a treating tower without carrier fibers, a special binder was needed. RB5 binder is working very satisfactorily with the silicone resin, and also appears to be useful with other resins. (Available date on felt-silicone laminates are given in Table 5.)

Conclusions

Pyrotex felts and mats are specifically tailored for high temperature applications where heat resistance and high strength are requirements. Typical parts using these products are shown in Figure 2. Fields of interest include missiles, rockets, aircraft structures, firewalls, electrical generators, turbine wheels exposed to heat, radomes, flame-resistant paneling, honeycomb construction, heat-resistant decorative paneling, etc.

—THE END

Developments in Polyurethanes, Unsaturated Polyesters, Polyvinyl Chloride, and Acrylonitrile Copolymer Blends.

(*Continued from page 475*)

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(*Continued on page 481*)

Copolymer Pipe Replaces Copper

A look down into a rotary sewage-filter reveals a maze of corrosion-resistant, rubber-resin piping.

Installation of Uscolite pipe, a styrene-butadiene-acrylonitrile copolymer blend produced by United States Rubber Co., has eliminated leak patching and repair at the world's largest sewage-treatment system. The Metropolitan Sanitary District of Greater Chicago has replaced copper piping with Uscolite in the 98 rotary filters at the West-Southwest Sewage Treatment Works, keystone of the district's $400-million system.

The installation was begun in 1948 on a test basis, and continuous checking has failed to reveal a leak or any other type of damage over the intervening years. The Stickney Works, as the West-Southwest Treatment plants are known, processed and converts domestic and trade wastes into fertilizer. The district serves Chicago and 85 suburbs, a population equivalent to 7,625,000.

The rotary vacuum-filters are used for sludge dewatering, and ferric chloride is added as a coagulant and filter aid. This combination of water, ferric chloride, and various acids was found to reduce thick-wall copper pipe to thumb-nail thinness in a very short period of time. The rubber-resin pipe now conveys ferric chloride into the sludge, and conducts the entire corrosive combination of acids and sludge through the filter screen without any deletrious effect.

Each of the 98 filters is 16 feet long and 11½ feet in diameter, and contains 820 feet of one-inch Uscolite pipe, several hundred drainage nozzles, lock nuts, division strips, and Uscolite fittings. The piping operates under room temperature conditions, and 30-inch maximum vacuum-type pressure.

—THE END

Developments in Polyurethanes, Unsaturated Polyesters, Polyvinyl Chloride, and Acrylonitrile Copolymer Blends.

(Continued from page 480)

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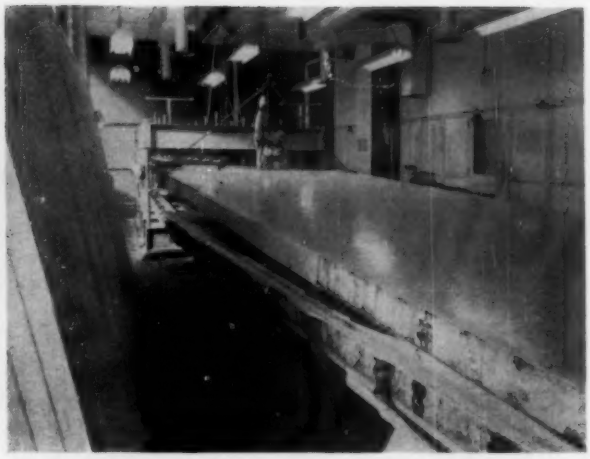
—THE END



Cured Convert-A-Frate panel emerging from the press.

Panels are cut-to-size and mitered.

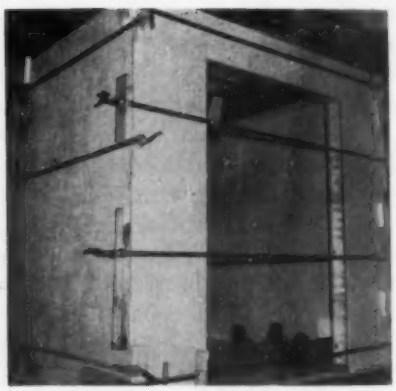
Scotchply-Faced Refrigeration Unit

Finished side-panel is lifted into place.

A new construction concept for railroad equipment—sandwich-type panel fabrication—has been incorporated into the Rock Island Lines' Convert-A-Frate refrigerated cargo unit. Essentially a portable, rectangular box mounted on a flatcar, the unit is made by bonding together mitered panels of Scothply-faced balsa wood.

Convert-A-Frate units can be "switched" by fork-lift trucks from railway flatcar to truck-hauled flatbed trailer and back again, thus making a single, uninterrupted trip from shipper to receiver. This eliminates time lags and additional carrying costs involved in the switching and routing lay-overs of entire railway cars.

The single-section panel sides and roof of the 17 by eight by eight-foot unit consist of 5¾-inch thick, flat-grain balsa cores faced with ⅛-inch Type 1002 isotropic Scotchply skins. The latter material, a product of Minnesota Mining & Mfg. Co., is glass fiber-reinforced epoxy resin in sheet form. The floor is a 2¾-inch, flat-grain balsa core surfaced on the top with plywood and ¼-inch Scotchply, and on the bottom with a ⅛-inch thick reinforced plastic skin.



Clamps hold panels in place during epoxy bonding.

The mitered panels are bonded at the joints with an epoxy-base adhesive instead of metal fastenings. Adhesive bonding, together with the non-conductivity of Scotchply, provides the box with a high degree of insulation free of the short-circuits which might be expected if metal fastenings were used.

The continuous plastic surface makes cleaning much easier, an important feature since the unit was designed primarily to handle shipments of meat. The high structural-strength of the material allows it to support 14,000 pounds of meat suspended from ceiling racks. Refrigeration is supplied by a thermostatically-controlled, dry-ice circulating system.

Top panel of refrigerated cargo unit is lowered into place. Note ceiling racks for suspending 14,000 pounds of meat.

PLASTICS TECHNOLOGY ENGINEERING FORUM

Vacuum Forming

Edited by:
E. BOWMAN STRATTON, *President,*
The Auto-Vac Co., Bridgeport, Conn.

In the vacuum forming field, the outlook for a widening range of applications is excellent, and is signaled by the appearance of many high-volume production requirements. Despite this continued expansion, many vacuum formers have experienced less than profitable operations. My purpose is to analyze the negative aspects of this new field by encouraging readers to contribute information which may help to clarify some of the obvious problems facing the new plastics sheet former.

Vacuum forming can be deceptively simple. Anyone owning an electric toaster and a stomach pump can produce a good sample. The transparent blister looks clean and brilliantly clear; the styrene box seems to have strong side-walls and uniform material distribution, and the polyethylene toy sample has no webbing or warping, and the customer is pleased. At this very point, the prospective contract looks so good that the inexperienced former becomes excited and begins to make the same series of mistakes that has been plaguing the industry from its inception.

In order to examine the pitfalls of vacuum forming, I have prepared a group of questions which I believe are important in this field. By printing a cross-section of the answers that are submitted, I hope that we can help prevent some current errors, and help some of the readers to realize a greater profit from their efforts. The six questions are:

(1) What is your rule-of-thumb method for figuring costs of forming and trimming in relation to materials cost?

(2) How much would you charge for one good sample in any one of the following three situations:

(A) Using the prospective customer's mold:

(B) Making a wood or plaster test mold; and

(C) First designing the part, then making the test mold.

(3) How much would you charge (in relation to know-how and machine time) for developing and testing a new design?

(4) What do you consider to be fair tolerances for plastic sheet specifications in the following thickness ranges:

0.005-0.020 inch,
0.025-0.060 inch. and
0.065-0.125 inch?

(5) What multiple of cavities (molds) should be tested before quoting on a 30,000-piece contract?

(6) What do you consider a reasonable percentage of rejects in a production run?

I hope these questions arouse enough interest to encourage many readers. Readers interested in developing further answers to their vacuum forming problems are invited and urged to submit more questions.

—THE END

Extrusion

Edited by:
A. A. KAUFMAN, *President*
Prodex Corp., Fords, N. J.

The annual tonnage of thermoplastic materials passing through extrusion machines is now greater than that of all other forming methods combined. Extruders are used in such widely different fields of plastic processing and forming as compounding and coloring, pelletizing, extracting, filtering and straining, calender feeding, sheet and film manufacture, laminating, continuous or valved preheating, continuous vacuum forming, wire and cable and, of course, in the traditional profiles, rods, tubes, and pipes. Extrusion techniques have been developed for all thermoplastic materials, including some unstable and highly heat-sensitive materials. Work has also progressed in the extrusion of some thermosetting materials.

Significant advances have been made in extrusion techniques in all of the above-mentioned fields. The greatest advance, however, was made in knowing more about the extruder itself.

Screw design based on sound theories has almost completely eliminated the trial-and-error method. The results are higher machine outputs at greater regularity and precision. Controlled shear rate, intermixing action, and higher working pressures produce extrudates of better compound uniformity. Increased screw and cylinder lengths (L/D ratio) permit processing at lower temperatures since there is more time available to get the necessary heat energy into the compound. This also permits the damping of the rheological effects caused by transformation of cold pellets or powder into a homogeneous hot melt. Self-generating or adiabatic operation also is easier to control in machines with greater L/D ratios. Proper screw design also has made possible higher circumferential speed of the screw without detrimental effect to the compound. Some development work is going on now on machines with small diameter screws from 500-1,500 rpm.

Better instrumentation permits observation of what, until recently, was "art and guessing". The combination of horsepower indicator, screw speed indicator, pressure gages before and after the breaker plate, and stock thermocouples permits observation and analysis of operating conditions and compound behavior. This combination of instruments is a welcome complement to the temperature control systems which indicate and control only the steel temperature of the cylinder or the temperature of circulating oil or steam. The total cost of proper instrumentation and control devices on a modern extruder, however, represents almost one-third of the machine cost itself, and this excludes motor speed controls. This investment, however, has been proved to be most advantageous.

Considerable attention has also been given to proper mechanical concepts of extrusion machines with the aim of bringing a maximum of the total available horsepower up front towards the die where it pays off in the form of increased output. Herringbone gear transmissions, ball or roller main bearings, and roller thrust bearings have become standard on high quality machines. Proper lubrication of main shaft and thrust bearing reduces horsepower losses as much as 7-10%. Close tolerances between cylinder and

screw diameter result in a marked increase in efficiency.

The higher output of the modern machine results in greater linear speeds of the extrudate itself and, in many cases, necssitates a more serious consideration of cooling length available after the machine. In some cases, it has been necessary to resort to refrigerated coolant. For example, an input of 50hp. converted into heat with a given quantity of material might necessitate the removal of as much as 20 hp. of heat energy within close distance of the die to permit proper shape holding and close tolerances. The removal of this energy might not be possible at high running speeds with normal-temperature water.

Single-screw vented extrusion machines, which permit extracting air, moisture, or other gases while maintaining high-output extrusions at close tolerances, have opened new possibilities in the extrusion field. They permit non-porous extrusion of many compounds and cross-sections without pre-drying and, in some cases, without costly precompounding.

The increased speed and efficiency of the extrusion machine has had a great impact on methods of compound preparation and on the design of take-off equipment. In the future, this column

(*Continued on page 491*)

News of the Societies

Design Engineering Conference

A three-day Design Engineering Conference, sponsored by American Society of Mechanical Engineers' machine design division, was held May 20-22 at the New York Coliseum. The Design Engineering Show, held concurrently with the Conference, is described in the News of the Industry section of this issue.

Session VI, a materials session held on the morning of May 22, included two papers which should be of interest to those engaged in the plastics industry. Abstracts of these talks follow:

"Plastics and Rubbers" were covered by Wyman Goss, General Electric Co., who brought out the design possibilities of plastics in today's automobile. Modern cars include about 15-20 pounds of such plastics as vinyls, styrene copolymers, acrylics, butyrate, Mylar polyesters, nylon, and phenolics. New developments and products were described by Mr. Goss, such as the high-density polyethylenes, polypropylenes, methylstyrenes, Du Pont's Delrin acetal resin, and GE's Lexan polycarbonate molding compound.

"Coatings and Finishes" was the topic of a talk by H. J. Reindl, Inland Mfg. division, General Motors Corp. He grouped these materials into three general classifications: organic coatings, metallic coatings, and conversion coatings. Organic coatings cover such plastic materials as epoxy and polyurethane varnishes, Hypalon polyethylene coatings, acrylic and vinyl lacquers, styrene-butadiene dispersions, PVA and acrylic latices, silicone primers, fluorocarbon dispersions, and vinyl plastisols. Factors which determine the finish to be selected are appearance, corrosion, sealing, electrical characteristics, thermal characteristics, frictional characteristics, abrasive wear, increased strength, and abrasion to other materials.

SPE Eastern New England

The Eastern New England Section, Society of Plastics Engineers, Inc., has announced the following officers for 1957: president, David Towler, M. W. Kellogg Co.; William Nissen, Bakelite Co.; secretary, George Kovack, Foster-Grant Co.; and treasurer, Robert Ward, Improved Machinery, Inc.

Directors, in addition to the above-named, are: Joseph Clancy, Emery Industries; Gim P. Fong, Raytheon Mfg. Co.; Alfred I. Simon, Raytheon Mfg. Co.; Josiah D. Crosby, Hood Rubber Co.; and Alfred G. H. Dietz, M.I.T.

SPE Quebec Section

"Every new material developed by industry must be evaluated first in terms of human safety," according to W. E. McCormick, director of industrial hygiene and toxicology for B. F. Goodrich Co. Speaking before the March 27 regular meeting of SPE's Quebec Section in Montreal, he pointed out the need of first assaying a material's possible adverse effects on the human body.

"One of the prime reasons for plastics acceptance," he added, "is their physiological inertness." To support this statement, Mr. McCormick described the use of vinyls in food handling and packaging. He further stated that "While the basic resins used in the compounding of plastics are notably inert, their modifying materials such as stabilizers, anti-oxidants, and plasticizers sometimes present health hazards."

SPE Milwaukee Section

The Milwaukee Section, Society of Plastics Engineers, Inc., has announced the following officers for the year of 1957: president, Kenneth F. Charter, A. O. Smith Corp.; vice president, Thomas R. Hardeman, Hardeman Laminating Co., Inc.; secretary, Kenneth H. Harrick, Sterling, Inc.; and treasurer, W. H. Brueggemann, A. O. Smith Corp.

Paul A. West, Sterling, Inc., and T. Walter Noble, Decar Plastics Co., will serve as national directors. Other directors, in addition to the above-named, are: Charles E. Egan, Owens-Corning-Fiberglas Corp.; A. J. Simmons, Plymouth Industrial Products; Harold Hulterstrom, Flambeau Plastics Corp.; and Clarence Stowe, Stowe Plastics Co.

SPE Newark Section

More than 100 members and guests attended the March 13 meeting of the SPE Newark Section, held at the Military Park Hotel, Newark, N. J. Three speakers addressed the group following dinner.

Howard H. Irvin, Marbon Chemical Division, Borg-Warner Corp., discussed "Cycolac, A Rigid, High-Impact Thermoplactic." The material is offered in three grades: H (for injection molding), L (for calendering and extrusion), and LT (for flame-retarding formulations). Property data was presented, notably density, impact strength, hardness, strength-weight ratio, and resistance to creep. Cycolac can be machined, drilled, and welded by conventional techniques.

E. Cronin, Hercules Powder Co., spoke on "Penton," a new chlorinated material reported to give strain-free moldings. Penton is injected into a die in the amorphous state, and relies on crystallization for hardening. Excellent dimensional stability is reported under adverse conditions, and a good balance of properties; fair tensile; elongation comparable to nylon; and good chemical resistance at 100° C. Applications include electrical rod stock, wire applications, gear and bearing retainers, monofilaments, and coatings.

R. H. Brandt, Fiberfil Corp., discussed "Glass Fiber-Filled Injection Molding Compounds," which are available as pellets containing 30-35% glass by weight. Fibers are in bundles containing 10,000-30,000 monofilaments, and these are retained during molding. These bundles are dispersed by high velocity through gating, and can be controlled to offer a wide range of properties. Characteristics exhibited are low water absorption, excellent moldability, high impact, and improved high-temperature properties.

SPE Buffalo Section

The Buffalo Section, Society of Plastics Engineers, Inc., has announced its officers for 1957 as follows: president, Robert W. Miller; vice president, Gordon K. Storin; secretary, Arthur A. Engl; and treasurer, Kenneth L. Ditzel, Lucidol Div., Wallace & Tiernan, Inc. Haiman S. Nathan will serve as national director.

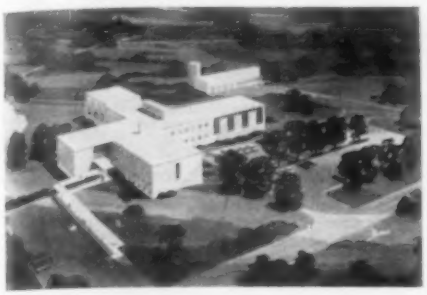
The board of directors, in addition to the above-named, are: Paul H. Brennenkant, Sterling Molders, Inc.; Richard A. Baumgartner; Herman J. Deney, Pierce & Stevens, Inc.; William J. Dunmyer, Carborundum Co.; Joseph P. Healey; Paul E. Logel; Eugene C. Roeck; and Peter L. Shanta.

BRI Plastic Group Meeting

"Plastics For Roof Construction" will be the theme of the Building Research Institute's Plastic Group meeting on September 17 and 18, at Washington University, St. Louis, Mo. Dean Joseph R. Passonneau of the Washington University School of Architecture will give a special report on the use of plastic materials in the construction of the entire roof structure. A system, devised by him, consists of a series of plastic pyramids tied at the top with steel rods.

The first day will be devoted to this and other reports on successful plastic applications. These will include actual costs of plastic vapor barriers, insulation, flashing, roof-surfacing materials, and skylights. The second day will feature a tour of the new Monsanto inorganic chemicals laboratory, which includes more than 80 different applications of plastics.

News of the Industry



Sketch of Escambia's future Research Center

Building New Research Center

Construction of a Research Center at Wilton, Conn., by Escambia Chemical Corp., New York, N. Y., is under way. The new Center, a 50,000-square foot building on a 46-acre site, will provide for research and development activities by the company, as well as customer and technical service laboratories. Specifically, its work will include research in petrochemicals, plastics, and related fields. Dr. N. C. Robertson, vice president and director of research for the company, will be in charge of the Center, and will be assisted in business affairs by R. G. Reed as business manager.

Since its organization in 1954, Escambia has conducted its own research and technical service activities at facilities in Cambridge and Newton, Mass., owned by National Research Corp., and will continue there until the firm occupies its new Center early in 1958. Some 60 patent applications in the petrochemicals field, which were filed by National, now have been assigned to Escambia.

Goodrich Plans Chemical Plant

Construction is now underway on B. F. Goodrich Chemical Co.'s new plant near Henry, Ill. Expected to cost over $5-million, the new unit should be on stream in early 1958 producing specialty organic chemicals. Plant operation will call for 80 employees.

A 240-acre tract was secured, and the chemical plants division of Blaw-Knox Co., was signed as general contractor. Initial construction phase will include three units: process building, office-warehouse-machine shop, and a steam-generating plant. Among the first-scheduled products will be anti-oxidants for use in the petroleum, plastics, rubber, and other industries.

Experimental Tumbling Shop

What is reported to be the world's largest experimental center for barrel finishing of plastics and metals has been opened by Lord Chemical Corp., York, Pa. A 40 by 120-foot plant addition contains the experimental tumbling room, a chemical laboratory, office, display room, and sample-storage space.

Thirty barrel-finishing machines, representing every available type (horizontal octagonal, horizontal hexagonal, triple-action, tiltable, submerged, wire-mesh, wooden tumbling, and wooden finishing barrels), are arranged along the two long sides of the room. A 1½-inch pipeline, located above each row of barrels, feeds water through individual one-inch lines. The double-pitched floor slopes toward two drainage channels to render it self-cleaning.

The smallest barrel has a 44.7-cubic inch capacity; the largest, a two-compartment barrel, has a capacity of 36.6 cubic feet. The shop can tumble workpieces from the smallest instrument pinion, weighing a fraction of a gram, to large parts weighing more than 100 pounds. Among the jobs handled are flash removal, metal cleaning and degreasing, descaling, deburring, abrasive- and non-abrasive cut-down, stock removal, finishing, formation of radii, coloring, burnishing, and mechanized drying.

Chip bins, with a combined capacity of 465 cubic feet, are used to store the fused aluminum oxide chips. Chip size ranges from fine sand to rounded chunks of 1½-2 inches in diameter. A vibrating-screen separator sorts the chips for reclassification after use. Steel shapes, shot, abrasives, ceramics, waxy spheroids, and abrasive granules are used for plastics deburring; hardwood cubes, pegs, and dowels carry the cream used to impart a high luster to plastic parts.

Other equipment includes compound racks, tables for work layout, a one-ton crane with electric hoist, vapor degreaser, and dip tanks. The firm presently markets 30 Lorco tumbling compounds, and offers custom service for special cases.

Sets Up Molding Department

An injection molding department, featuring the latest in equipment, has been established by Stanley Chemical Co., a subsidiary of Stanley Works, located in East Berlin, Conn. The new department will handle all types of custom work, and is inviting inquiries about its services.

The move represents another step in Stanley's expansion program, and is expected to provide better service and products in the plastics and industrial finishes fields. Stanley also offers custom formulations.

Borden Acquires Subsidiary

A manufacturer and processor of extruded plastics, Lawrence Process Co., Inc., North Andover, Mass., has been acquired by Borden Co.'s chemical division. It will operate as a wholly-owned subsidiary of the Borden Co.

Lawrence's 46,000-square foot factory was completed two years ago, and includes a completely-integrated extrusion & compounding plant, laboratory, and die & machine shop facilities. About 130 workers are employed.

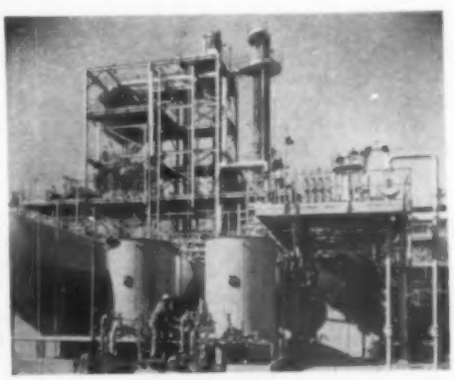
The acquisition makes Borden the first vinyl extruder with both East and West Coast plants. Last year, Borden took over Resin Industries of Santa Barbara, Calif., now known as the Resinite department. Grant C. Ehrlich, manager of that department, will be responsible for coordinating operations of the two plants.

Starts Commercial Production

Large-scale commercial production of Marlex 50, Phillips' high-density polyethylene, is now underway at the Adams Terminal chemical works near Houston, Tex. Capacity is scheduled to reach 75 million pounds-per-year during the last half of 1957, as additional equipment is installed.

An ethylene plant of 180-million pounds initial capacity will supply the basic material through a 75-mile pipe line. Underground caverns washed from deep salt formations, near the Sweeny Refinery, will store the ethylene. Marlex production will be under the control of Phillips Chemical Co., a wholly-owned subsidiary of Phillips Petroleum Co.

Phillips' sales-service laboratory in Bartlesville, Okla., will assist plastics fabricators in processing and developing new applications for the material. The lab has standard, production-line machines for testing under conditions of manufacturing and use.



Section of Phillips' new Marlex plant near Houston, Tex.

Automatic Four-Color Spraying

Automation in the painting department has brought about labor savings of more than 75% at G. Felsenthal & Sons, Inc., Chicago plastics fabricator and injection molder. As many as four automobile speedometer or clock dials are sprayed with four colors simultaneously, as opposed to the individual spray-technique previously used.

Using a turntable, four spray nozzles, and a single mask, one operator handles the complete operation. The dials are placed on the turntable, which is raised up against the mask by means of a hand lever. A foot pedal rotates the table during spraying. Finished parts are placed on a conveyor belt for routing to other parts of the plant.

Masks, turntable, and nozzles are designed to direct the right color to the right opening in the mask. Nozzles are set at varying distances from the center of the table to prevent mixing of colors. Readjustment for different jobs is reported to be simple.

Schedules Silicone Laboratory

Construction of a new product and process development laboratory has been scheduled by General Electric Co.'s silicon products department, along with a further expansion of other departmental facilities. Total outlay for the Waterford, N. Y., project has been set at $3-million, and the new laboratory should be ready for occupancy in January.

The two-story research building will be erected on a 69-acre site, adjacent to the original plant. Conceived as the first step in the establishment of a silicone technical center, it will include complete library facilities as well as research equipment. GE's research laboratory in Schenectady will continue its fundamental research in silicones, a field in which it pioneered.

Weber Enters Plastics Field

The establishment of Weber Plastics, Inc., marks the entry of Weber Lifelike Fly Co., Stevens Point, Wis., into the field of plastics molding. The firm, one of the country's major manufacturers of fishing tackle, has already produced a plastic float ring for minnow buckets and plastic bodies for fly and spinning lures.

Weber's ring bucket-float weighs a mere 1½ ounces, but is said to support the weight of a 180-pound man. The plastic lures are more durable than cork and, being lighter, float better. Plastics also permit the "molding-in" of the humpshank hook in another type of lure.

Other fishing products contemplated by Weber Plastics include duck decoys, bobbers of expandable polystyrene, and vinyl-plastisol wiggly worms. Other plastic items not directly connected with fishing will be included in the company's custom-molding operations.

Airtight trailer for bulk shipments of Eastman resins has three separate compartments.

Adopts Bulk-Handling Methods

Flex-O-Glass, Inc., Chicago, Ill., is taking advantage of Eastman's bulk shipments of Tenite plastics to reduce materials-handling costs. The materials are shipped by trailer truck, in airtight compartments, and are airveyed to storage tanks or silos with a 25-hp. blower.

Forty feet of six-inch, flexible hose are attached to Flex-O-Glass' filling line by means of a spring-loaded ratchet. The firm has two aluminum silos, each with a capacity of 35,000 pounds. Later, materials are transferred to processing equipment by electric-powered screw conveyors.

The cost reductions made possible by bulk handling include the elimination of labor and equipment required for other unloading methods, minimizing of storage area, and the facility of material transfer to the production area. Eastman recommends that customers have storage tanks of approximately 1,000 cubic feet, located so that the delivery line does not exceed 100 feet. Trailers currently used for bulk shipment have three compartments, each with a capacity of 7,000-10,000 pounds depending upon the material shipped.

Pro-phy-lac-tic Buys Plant

The Propper-McCallum plant in Florence, Mass., has been purchased by Prophy-lac-tic Brush Co., including much of the adjacent land. The 43,000 square feet of work space will be given over to raw-material storage and finished goods handling, as well as release additional manufacturing space at the original plant.

No major change in the physical facilities is expected, since the floor space involved is well suited to its intended use. Approximately 30 people will be employed, all transfers from the Riverside Drive plant and other warehouse buildings.

Announces Name Change

Budd Co's wholly-owned subsidiary, Continental-Diamond Fibre division, Newark, Del., has undergone a change in corporate name to Continental-Diamond Fibre Corp. The change does not affect the established relationship between the two firms.

Continental-Diamond Fibre has engaged in a substantial expansion and modernization program over the past 18 months, with a capital expenditure of over $3,750,000. The firm maintains plants in Newark, Del.; Bridgeport, Pa.; Valparaiso, Ind.; Spartanburg, S. C.; and Toronto, Canada.

Builds Processing Plant

Construction is currently underway at Carrollton, Ky., site of Metal & Thermit Corp.'s projected $3-million chemical processing plant. Scheduled for completion in December, the facility will produce organo-tin stabilizers for vinyls, transformer oils, biocidal and fungicidal agents, and other chemical products. Production of organic zinc and cadmium compounds is planned for the future.

Initial plant facilities will include a 3,000-square foot office building, a 2,800-square foot boiler house, a system of wells with water tower, and 18,300-square foot operating and product warehouse, and four 1,000-square foor service buildings. Design provides for 40,000 square feet of operating area, as well as future three-fold expansion of existing facilities.

Metal & Thermit hopes to turn out 2½-million pounds of chemical products during the first year of operations. By 1966 this figure should be increased to 7 million, according to company spokesmen. The new plant will employ 35-45 people at the outset; 75 by 1966.

Announces Acrylonitrile Plans

Acrylonitrile production will be doubled by the second quarter of 1958 at Carbide & Carbon Chemicals Co.'s Institute, W. Va. plant, according to company spokesmen. Demand for acrylic fibers, high-impact resins, Buna-N type rubber, and other acrylic derivatives was cited as the reason.

New thermoplastic terpolymers of acrylonitrile, butadiene, and styrene have both high-impact and high-distortion strength. Two new derivatives of acrylonitrile, dimethylamino propylamine and diethyl amino propylamine, have found application in the manufacture of textile softeners. Acrylonitrile has shown promise also, as a cyanoethylating agent for upgrading the mildew resistance of cotton.

Sets-Up California Operation

Polymer Corp., Reading, Pa., has established a plant in Santa Ana, Calif., for custom coating by the Whirlclad process. This new coating technique involves dipping preheated articles in a bed of finely-divided dry powders, which are fluidized by ascending currents of gas or air. The heat, in turn, fuses the powders to form

the coating.

The Whirlclad process is based on inventions of the Knapsack-Griesheim division of Farbwerke-Hoechst, a German firm. Polymer Corp. will operate in Santa Ana under a license from Polymer Processes, Inc., which holds the exclusive American patent and licensing rights to the fluidizing-bed technique.

A wide range of plastic materials can be used such as nylon, polyethylene, cellulosics, epoxies, and polyethers. A single dip produces coatings with high chemical resistance, wear resistance, electrical insulating properties, and decorative effects.

Design Show Doubles in Size

Nearly 20,000 technical and sales representatives attended the second annual Design Engineering Show, held at the New York Coliseum on May 20-23. Sponsored by the machine design division of the American Society of Mechanical Engineers, the show featured more than 10,000 products displayed by nearly 400 manufacturers. Having more than doubled in size over the last year, the show now rates among the top five annual industrial expositions in the country.

Among the highlights of the show was the Dow Corning booth, which featured a D. C. motor completely insulated with silicones. This Silastic Type L interlayer was developed originally for high-temperature, safety glass windshields on supersonic aircraft. Dow Corning 7501 and 7521, solventless-silicone impregnating resins, also were displayed.

B. F. Goodrich Chemical Co. had many Geon polyvinyl materials on display, including such products as welded vinyl housings; plastisol-coated metals; foam and sponge; rigid vinyl pipe; and special extruded shapes.

E. I. du Pont de Nemours & Co., Inc., exhibited urethane foams based on Hylene organic isocyanates, as well as Lucite acrylic moldings, Alathon polyethylenes, Teflon, and Mylar polyester film. A number of other firms also displayed Teflon combinations and moldings, and Mylar laminates.

O'Sullivan Rubber Co. featured Sulvyne-Clad, plastic sheeting bonded to flat sheets of aluminum, steel, and magnesium; and Sullvac, a rigid and semi-rigid copolymer sheet for vacuum forming.

A three-day Design Engineering Conference was held concurrently with the show, and drew an aggregate attendance of 1,750. Papers presented, which should be of interest to those engaged in the plastics industry, are abstracted in the News of the Societies section of this issue.

To Build Vinyl Stearate Plant

Air Reduction Chemical Co., New York, N. Y., will produce vinyl stearate in com-

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In a typical test, 64 parts of HARFLEX® 300, preheated to 212° F, were mixed with 100 parts of an easy-processing polyvinyl chloride resin at 212° F. After 30 minutes of thorough agitation, a dry, free flowing powder was obtained which could be put directly into an extruder. When a free flowing dry blend is used directly, as in extrusion operations, it is possible to eliminate or minimize extra operations such as Banbury mixing or roll milling.

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mercial quantities at Calvert City, Ky., by the end of this year. The new plant will have an annual capacity of two-million pounds, employing a process developed in the firm's research laboratories. Polyvinyl stearate, a hard synthetic wax, also will be produced. The new plant is the fifth to be built by Air Reduction on its 1,500-acre site in Calvert City.

Vinyl stearate-vinyl acetate copolymers make excellent vehicles for exterior emulsion paints, giving tough, flexible films with high water resistance. When vinyl stearate is copolymerized with vinyl chloride, the resulting plastic is a flexible and stable coating material that does not bleed. Copolymers containing a lower percentage of vinyl stearate are rigid materials which can be used in plastic tubes, pipe, floor coverings, phonograph records, and toys.

Discovery Aids Polyethylene

A discovery by the research and development department of Godfry L. Cabot, Inc., Boston, Mass., is said to make possible a new range of usefulness for polyethylene and other plastics. Named the CAB-XL process, it employs chemical methods and conventional maunfacturing equipment. New compositions of matter are created in which finely-divided pigments and polymer are combined in an especially effective manner. Carbon black loadings can be used to an extent previously regarded as impossible. A new order of strength is created enhancing the value of plastic materials for structural applications where rigidity and pressure resistance are essential. Creep and fracture, two of the most serious limitations of plastics, virtually are overcome.

Major development of the discovery has concentrated on improving the utility of polyethyene. In this plastic, the use of high loadings of carbon black has not been practical in the past because it resulted in excessive embrittlement. Now, CAB-XL compositions of polyethylene containing 50% or more of carbon black remain flexible even at extremely low temperatures.

The Cabot laboratories have demonstrated the usefulness of the discovery in a variety of molded and extruded products. Polyethylene pipe continuously fabricated and containing 100 parts of carbon black exhibited an unusual combination of properties, including resistance to stress cracking, improved high-temperature behavior, virtual elimination of plastic flow, and improved resistance to deterioration by solvents and oils. Laboratory tests indicate that burst strength has been doubled, both at room and elevated temperatures. Experiments with polyethylene compositions for wire and cable coverings show promise, since results duplicate those for polyethylene pipe, and unusually smooth extrusion is another valuable benefit.

Lester-Phoenix's new machining plant.

Completes Auxiliary Plant

A two-story brick building has been completed by Lester-Phoenix, Inc., in Cleveland, O. Designed for machining operations on the firm's injection molding machines and die casting machines, the plant is an integral part of Lester's integrated, cost-control program. Inspected components are delivered to the nearby main-plant for assembly.

Begins Independent Operation

The fiber glass and reinforced plastics operations of Bigelow-Sanford Carpet Co., Inc., New York, N. Y., have been purchased by Fiber Glass Industries, Inc., a new organization located in Amsterdam, N. Y. The transferred operations, also located in Amsterdam, N. Y. employ about 100 persons. Officers of the new company are A. T. Dildilian and R. B. Knowles. Mr. Dildilian, the president, formerly was general manager of the fiber glass and reinforced plastics activities at Bigelow-Sanford, while Mr. Knowles, the new vice president, formerly was manager of Bigelow-Sanford's reinforced plastics division. The formation of the new company and its purchase were arranged primarily through the financial resources of the New York Business Development Corp.

In the cash purchase, Fiber Glass Industries obtained the machinery, equipment, and inventory of the two Bigelow-Sanford operations, and assumed obligation to meet delivery schedules for current orders. The fiber glass and reinforced plastics operations are conducted on leased property formerly owned by Bigelow-Sanford. The fiber glass operation manufactures woven cloth and mechanically-bonded mats, while the reinforced plastics operation makes specialized products for industrial and military application.

Constructs Fifth Laboratory

Construction is presently underway at Chestnut Run, near Wilmington, Del., on Du Pont's fifth sales-service laboratory. Scheduled for compleion by the Spring of 1958, the laboratory will be operated jointly by the pigments and electrochemicals departments.

The cost will approximate $5-million, and its design will resemble that of the other four red-brick and steel-frame units. Customer service and development work will be conducted on titanium, silicon, pigments, sodium, peroxygen, chlorine, vinyl, and related products.

The new building will have over 81,000 square feet of floor space. The one-story electrochemicals wing will accommodate 50 workers, and the two-story pigments section will provide accommodations for twice that number. Lobby, meeting rooms, and library will be shared.

The electrochemicals department will transfer its operations from Niagara Falls, and will continue development programs on textiles, paints, adhesives, films, paper sizes, and coatings. The color sales-service laboratory will move its operations from Newark, N. J., as will the white-pigments laboratory at Newport, Del.

The pigments department will have complete technical service facilities for titanium metal and silicon, including seven laboratory rooms. Ball and roller mills and other facilities for incorporating pigments into plastics, paint, rubber, and paper will be established.

Schedules Cellophane Plant

Approximately 600 acres of land near Tecumseh, Kansas, have been purchased by E. I. du Pont de Nemours & Co., Inc., for the erection of a new cellophane plant. Scheduled for operation by early 1959, the plant will employ 600 and will be operated by the company's film department. Cost is expected to run well into eight figures.

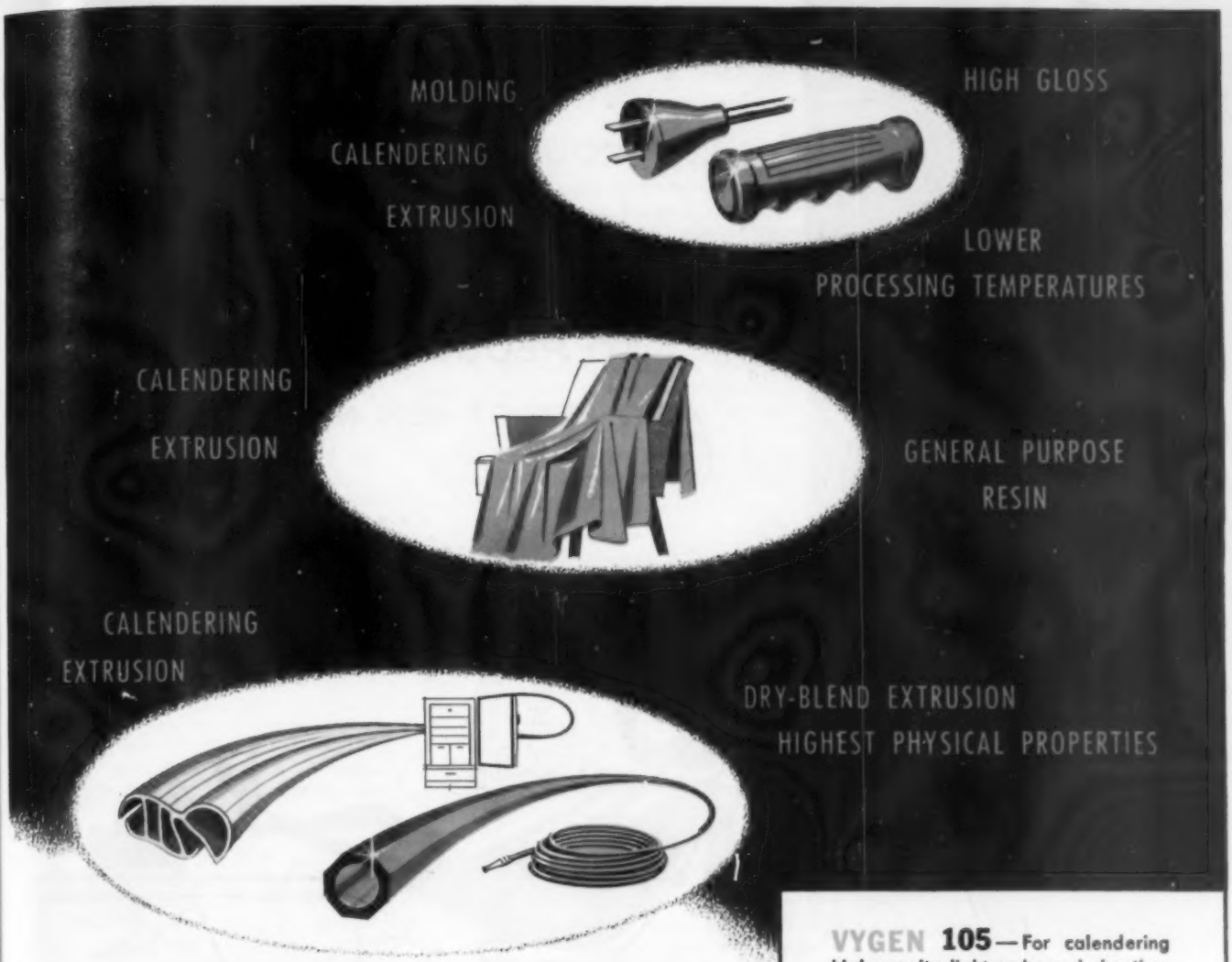
Du Pont has more than doubled its cellophane capacity during the postwar period, and recently announced an expansion program designed to produce an additional 30-million pounds annually from existing plants. The new facility will have a capacity of around 50-million pounds-per-year, and will incorporate the latest improvements in automation and quality control.

The Tecumseh plant will be the fifth such facility operated by Du Pont. Other locations include Buffalo, N. Y.; Old Hickory, Tenn.; Richmond, Va.; and Clinton, Ia.

Clear Vinyl Seat Covers Gain

While other types of auto-seat covers maintained their general sales levels, clear vinyl shows a gain of 34% over the past six months. This fact was revealed at the recent annual meeting of the Automobile Seat Cover manufacturers Association in New York City. Clear vinyl covers now make up more than 25% of all unit and dollar sales.

The Association approved a $150,000 nationwide campaign to promote seat covers, and the week of May 21-30 has been designated as Good Car Keeping Week. A second series of national advertisements will appear about that time, designed to promote car upkeep through care of the car's interior. ASCMA is made up of seat cover and fabric manufacturers, and comprises a $300-million industry.



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With the development of these specialized vinyl resins, General's Chemical Division is prepared to put the *right* PVC resin to work for you. All three have good heat and light stability, high-bulk density, very good clarity and exceptional uniformity. For technical assistance and detailed information on the VYGEN resin for *your* operation, just drop us a line on your company letterhead. We'll be glad to work with you on that "tough" problem.

VYGEN 105—For calendering high-gravity light-embossed sheeting, and for molded items and extrusions requiring a high-gloss finish. This resin can be processed alone or with other resins, permitting lower processing temperatures.

VYGEN 110—A general purpose, average molecular weight resin, especially adapted for easy processing of calendered film, sheeting and coated fabrics . . . also recommended for certain molding and extruding applications.

VYGEN 120—A high molecular weight resin ideally suited to dry-blend extrusion operations with monomeric or polymeric plasticizers . . . excellent, too, for calendering when maximum physical properties are desired.

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TO REDUCE BREAKAGE

AND LENGTHEN MOLD LIFE

As Mold Release Agents

Breakage is reduced, mold life is lengthened and surfaces come out clean when Witco Stearates are used to lubricate mold surfaces. Special grades of Witco's Zinc and Calcium Stearates can be dusted directly onto mold surfaces, or easily dispersed to dilute water suspensions that apply easily and uniformly with spray or brush.

As Internal Lubricants

Smoother mold flow, giving sharp detail to finished articles, is obtained by incorporating small percentages of Witco's Barium, Calcium, Zinc or Lead Stearates into the molding compounds. This lubrication also benefits subsequent processing steps.

You can benefit from Witco's long experience in serving the plastics industry. Just call your nearest Witco office for quick deliveries... or for practical information on metallic stearates that can help in your operations.

Witco products for the plastics industry include:

Witco Stearates
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Witcarb® Extenders
Fomrez* No. 50 Polyester
Witco 77-86 Coupler
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In Brief . . .

American Viscose Corp.'s film division, Philadelphia, Pa., has announced a 4-5% increase in the price of Avisco cellophane. Increased labor and raw material costs were cited as underlying reasons for the increase.

Sprits, manufacturers of a mold release agent having the same name, has moved to larger quarters at 146 Merrick Road, Lynbrook, N. Y. The firm formerly was located in the Bronx, N. Y. C.

Dow Chemical Co., Midland, Mich., has announced price reductions of 10-15% on its standard Styrofoam boards. These include the three-, eight-, and nine-foot length in 12- and 16-foot widths.

Plastic Materials, Inc., compounders of thermoplastic materials, has moved to a larger plant at New South Road, Hicksville, N. Y. The company plans to expand its production of virgin cellulose acetate, polystyrene, polyethylene, and acrylics, plus such specialties as pearl molding powder, tinsels, phosphorescents, and metallics.

Altoona Trans-Audio Corp., has installed Curtiss-Wright Curon wall tile at Station WRTA in Altoona, Pa. Listener response reportedly verified the claims of improved acoustical characteristics. Sound absorption was excellent.

G. Felsenthal & Sons, Inc., Chicago, Ill., has been awarded a $150,000 procurement contract by the Air Force for three scratch-resistant, waterproof, navigational computers made from plastic.

Haveg Industries, Inc., Wilmington, Del., has increased its production of Teflon-insulated hook-up wire in sizes 14-30. Insulation thicknesses range from 0.01 to 0.015-inch.

General Tire & Rubber Co.'s Pennsylvania division has adopted the Sanitized process for producing vinyl film. Incorporated during manufacturing, the process impregnates the film with a bacteria-repelling agent which retards odor and fungus formation.

Reliance Electric & Engineering Co., has moved its general offices to 24701 Euclid Ave., Cleveland 17, O.

E. I. du Pont de Nemours & Co., Inc., has announced, through its elastomer chemicals department, that licensees are no longer required to pay the 1½% royalty on the manufacture of urethane foams and coatings. This involves, of course, only those licensees using Du Pont patents.

Phillips Petroleum Co., Bartlesville, Okla., has licensed Showa Denko K. K., Tokyo, Japan, to use the Phillips-developed catalytic process for making rigid polyethylenes. The agreement grants Showa Denko exclusive use in Japan of Phillips' patents and technical knowledge on this subject.

A. E. Fleming Co., Detroit, Mich., has been appointed exclusive distributor for Mimeral & Chemicals Corp., of America products in the State of Michigan, Northwestern Ohio, and Northeastern Indiana. Complete warehouse stocks will be maintained in Detroit.

General Tire & Rubber Co., has announced that its Syloy, fibrous glass-reinforced polyester, sign panels have been installed along the new Massachusetts East-West Turnpike. Virtually indestructible, the signs have a built-in green color.

Filon Plastics Corp., El Segundo, Calif., has added two regional operations: namely, warehouses in Chicago and suburban New York City. The firm manufactures reinforced plastic building panels.

D. Nast Machinery Co., Philadelphia, Pa., has been appointed agent for Hamilton presses in the Philadelphia area. The territory includes Eastern Pennsylvania, Southern New Jersey, and the entire State of Delaware.

Injection Molders Supply Co., Cleveland, O., has ben awarded an exclusive license to manufacture and distribute injection machine heating cylinders under Patent No. 2,766,483 issued to Jerry C. Stokes, president of Perry Plastics, Inc.

Sylvania Electric Products, Inc., held an "Open House" on March 6 at its recently-completed plastics plant in Warren, Pa. The 110,000-square foot installation contains the latest thermosetting and thermoplastic molding and finishing equipment.

E. I. du Pont de Nemours & Co., Inc., Wilmington, Del., has announced an increase of 3¢ per pound in the price of its cellophane, bringing the cost to 62¢ per pound for the most commonly used types.

Resins, Inc., an associate company of Reichhold Chemicals, Inc., is building a plant in Manila, P. I. The firm will manufacture synthetic resins under license from Reichhold. using the latter's technical knowledge and processes.

Frank W. Egan & Co., has announced plans for doubling the size of its plant in Somerville, N. J. The new wing wil provide an additional 16,000 square feet of floor space.

Middletown Rubber Corp., Middletown, Conn., has introduced a triple-textured, three-dimensional, valley-printed vinyl fabric called Tri-Tex. First pattern in the line is designated Venetian Flounce.

Tee-Pak, Inc., Chicago, Ill., has announced the formation of a cellulose packaging division for the production of cellulose-banding materials. The bands will be used in merchandising multi-paks, as overwraps, and for banding a premium to a product.

Allied Chemical & Dye Corp., New York, N. Y., has announced that all sales of A-C Polyethylene Wax, formerly handled by the Semet-Solvay petrochemical division, will be handled by the chemical sales department of the Barrett Division. The product will be known as A-C Polyethylene Lubricant.

Crown Zellerbach Corp., San Francisco, Calif., has announced the establishment of a new Fiber division for the sole purpose of promoting and selling Crezon. This material, a resin-impregnated cellulose-fiber sheet, is permanently fused to wood under heat and pressure. The move marks Crezon's graduation from a new-product promotion to a proven, profitable product.

Cadillac Plastic & Chemical Co., Detroit, Mich., has been appointed distributor for the following firms: Raybestos-Manhattan, Inc.; Chicago Molded Products Corp.'s Campco division; Wasco Products, Inc.; and Sigma Specialty Chemicals.

Synthane Corp., Oaks, Pa., has opened new and expanded Western headquarters at 1260 South Central Ave., Glendale 4, Calif. Providing over 7,200 feet of warehouse and office space, the new facility will carry a larger stock of all grades of Synthane sheets, rods, and tubes. Overnight service is available to customers in the San Francisco area and in Arizona.

Extrusion

(*Continued from page 483*)

will attempt to cover extrusion equipment and techniques more specifically.

The fast progress of the extrusion industry was made possible by the enthusiastic acceptance of new equipment and designs and new techniques by the majority of processors; a group of forward-thinking young men in a young industry without prejudices or false traditions.

—THE END

News from Abroad

West German Plastics in 1956

Figures published to date point to a 20% increase in production by the West German plastics industry during 1956, as compared with 1955. Since 1953, Germany again has become the world's second largest producer of plastics materials (after the United States). This is a notable achievement when it is considered that output by West Germany in 1947 was only 23,000 tons, less than 10% of the pre-war high of 250,000 tons reached by the whole Germany in 1944. The German plastics industry now tops all branches of the domestic chemical industry in industrial production, having accounted for about 10% of the annual total for that country's chemical industry.

The first table shows production of the main classes of plastics for all Germany in 1938 and 1944, and for West Germany from 1950 through 1956. The statistics are thousands of tons, but no details are given for 1944 outputs.

The figures reveal that while there has been a steady increase in output since 1950, the rate has been dropping, markedly so last year.

West German export trade after the war did not resume significant proportions until 1950. The Korean war gave the business an extra big boost. There was a slight set-back in 1952, which was more than made up for in 1953. In the succeeding years, the rise continued, but the rate of increase slowed down gradually from more than 66% in 1953 to about 25% in 1956. About 70% of the total volume of exports in 1956 went to other European countries, and the balance went overseas. The development of this export business is shown in the second tabulation:

The average number of persons employed by the West German plastics industry rose from 21,000 in 1950 to 32,000 in 1953, 38,000 in 1954, 45,000 in 1955, and about 52,000 in 1956.

A survey of recent developments reveals that an expansion of productive capacity of various plastics has been undertaken, particularly PVC, polyethylene, polystyrene, methacrylates, polyurethanes, and unsaturated polyesters. The renewed interest in cellulose derivatives, caused chiefly by growing demand for transparent packing materials, is shown by the increased output last year that was more than 20% above that of 1955. There also was much more activity in injection molding during last year, reflected by a rise of more than 53% in domestic production of injection molding compounds.

Among the newest German plastics that have come to public attention recently are the polycarbonate plastics, and Novodur, a copolymer of butadiene, styrene and acrylonitrile; both products are claimed to have unusual properties.

	1938	1944	1950	1951	1952	1953	1954	1955	1956
Cellulose derivatives	31	—	28	31	29	39	47	50	62
Condensation products	44	—	40	81	80	97	130	175	198
Polymerization "	2	—	30	56	81	104	148	200	245
Total:	77	250	98	168	190	240	325	425	505

	1950	1951	1952	1953	1954	1955	1956
Exports, tons	9,900	25,600	23,800	39,600	61,000	87,500	110,000
Value, million DM	30	102	101	146	219	298	360

1957 British Exposition and Convention Planned

This year's British Plastics Exhibition will be held on July 10-20 at Olympia London Grand & National Halls, in conjunction with a convention featuring talks by 22 leading authorities on plastics. For the first time, this convention will be an international event, with speakers from various countries on the program, and attendance anticipated from all countries.

Papers to be presetned at the convention are listed as follows: "Synthesis and Properties of Linear Polyolefins," H. F. Mark, Brooklyn Polytechnic Institute; "Some Aspects of Low-Pressure Polythenes," Erhard Grams, Farbwerke Hoechst A. G. (Germany); "Light Scattering of Polythene in Solution," P. B. McFarlane, F. Yearsley, and S. W. Hawkins, Imperial Chemical Industries, Ltd.; "Permeability of High-Density Polythene Film," V. T. Stannett, State University of New York; "The Physical Properties of Lightly Plasticized PVC Compounds," R. A. Horsley, BX Plastics, Ltd.; "High-Impact Vinyl Materials," C. E. Parks, B. F. Goodrich Chemical Co.; "Foamed Polyvinyl Chloride," D. A. Lever and G. Burke, British Geon, Ltd.; "Foamed Polyesters and Polystyrenes," E. M. Evans British Resin Products, Ltd.; "Some Recent Developments in Extrusion," A. Kennaway, I. C. I.; "Developments of Extrusion in Germany," G. Schenkel, Paul Troester Maschinenfabrik (Germany).

Also "The influence of Preplasticization in Injection Molding," E. Gaspar and M. G. Munns, Projectile & Engineering Co., Ltd.; "Injection Speed Considerations," L. W. Meyer and L. E. Tallman, Dow Chemical Co.; "A study of Injection Molding of Toughened Polystyrene," G. Hulse and A. Z. Borucka, Monsanto Chemicals, Ltd.; "Recent Developments in Fluorine Polymers," G. W. Bowley, I. C. I.; "Recent Developments in Arc-Resistant Thermosetting Molding Materials," J. Hefton and C. P. Vale, B. I. P. Chemicals, Ltd.; "Relative Merits of Epoxide, Phenolic, and Polyester Resins in Glass-Reinforced Plastics," L. H. Vaughan, Bakelite, Ltd.; and "Reinforced Plastics for Efficient Structures," W. A. Baker, Bristol Aircraft, Ltd.

Largest European Moldings

More and more French molders are installing injection molding machines having capacities ranging from 1-6 kilograms (about 2.2-13.2 pounds). With the aid of an HPM machine having a capacity of six kilograms, one firm, which specializes in large parts, molds high-impact polystyrene refrigerator doors measuring 1,250 by 670 millimeters (about 50 by 26½ inches), 2.4 millimeters thick, and weighing 3.2 kilograms in a 75-second cycle, a rate thought to be unequalled in Europe for this size and thickness. From the same plastic, the company also injection molds refrigerator door liners measuring one meter high by 45 centimeters deep, and weighing 3.5 kilograms in a cycle taking 1½ minutes. The material in this case is 2.5-millimeters thick. The average capacity of French refrigerators is about 3.5-7 cubic feet, which gives the French manufacturer an advantage in injection molding of doors and liners over his opposite number in the United States, where refrigerators usually are much larger.

The same firm also has been experimenting successfully with the injection molding of large parts from Rilsan (the French castor oil-based polyamide). Using the HPM machine, it has been able to produce an injection-molder refrigerator door weighing 1.5 kilograms. Tests reportedly have indicated the possibility of producing the doors on an industrial scale. Another large part produced from Rilsan is a special container weighing almost two kilograms.

British Plastics in 1956

The British plastics industry continues to forge ahead, and 1956 production and export statistics reached new heights. At approximately 335,000 tons (in round numbers), production last year showed an increase of more than 10,000 tons over the 1955 total of 324,000 tons. The rate of increase, however, was lower than for 1955, when the total was 50,000 tons above the 1954 amount of 274,000 tons.

Thermoplastics again accounted for the major part (more than 50%) of output last year, and included PVC, polyethylene, and polystyrene. Exports of plastics materials (consisting of molding powders, resins, sheet, rod, tube, film, and foil) last year amounted to nearly 98,000 tons valued at more than L.26,000,000. This compares with about 85,000 tons valued at roughly L.23,000,000 in 1955, and some 73,000 tons valued at L.20,500,000 in 1954. Australia, as usual, was Britain's best customer, while India, France, Netherlands, South Africa, Italy, and Denmark, in that order, also took substantial amounts of British plastics.

Since 1950, production by the British plastics industry has more than doubled. Additional facilities permitting a still-further rise in output, will be available when expansions now in progress are completed. Exports have not lagged either; in 1956, they were close to five times the 1947 total of 21,000 tons, and 20 times that for 1938 (4,300 tons).

Production of PVA Emulsions

The Electro-Quimica de Flix, S.A., Flix, Spain, in collaboration with Farbwerke Hoechst A.G., Frankfurt/Main-Hoechst, Germany, is scheduled to start the production of polyvinyl acetate emulsions early this year. An annual output of 1,400 tons is expected, in addition to adequate supplies of polyvinyl acetate and polyvinyl alcohol.

French to Make Polyfluoroethylene

The four important French concerns, Pechiney, Rhone-Poulenc, Saint-Gobain and Ugine, all with main offices in Paris, have decided to establish a joint company for the manufacture of polyfluoroethylenes. The new enterprise, to be known as Societe des Resines Fluorees, will have a capital of 200,000,000 francs.

Piano with Plastic Action

One of the attractions at the Fourth Chemical, Rubber and Plastics Exhibition, held in Paris, France, on November 22-December 3, 1956, was the piano with plastic action shown by Societe Pleyel, the well-known French piano manufacturer. The large number of parts, mainly of wood, which go to make up the action (the mechanism for sounding the strings of the piano) have been replaced by fewer parts molded from cellulose acetobutyrate. It is expected that the new piano with plastic action will be cheaper to produce, will be more satisfactory in tropical countries, and will require less frequent tuning than the conventional type.

Tacryl Synthetic Fiber

The Swedish concern, Stockholms Superfosfat Fabriks Aktiebolaget, Stockholm, recently produced a new polyacrylonitrile fiber, marketed under the name of Tacryl. The chief difference betwen Tacryl and older fibers is that it is made by the wetspin process. The Swedish experts succeeded in finding a mixture of aliphatic compounds which avoided the defects resulting when earlier attempts to use the wet-spinning method were made. Tacryl can be used to make knit garments for outer and under wear, blankets, quilts (including filler), and the like.

Infra-Red Heater Uses Gas

A French firm has put on the market a bright type infra-red heater using gas by which processing time is claimed to be cut in half. With this so-called Schwank-type device, polystyrene two millimeters thick was heated uniformly to the proper degree of softness needed for welding in 47 seconds, whereas 85 seconds had been the best time obtained previously.

The Schwank infra-red heater uses a wave length of 2.4 microns, corresponding to an emission temperature of about 900 (Wien's Law.) This temperature is claimed to be distributed uniformly over the entire surface of the transmitter. The device can be used in any position, particularly in the horizontal position for vertical radiation. City gas, natural gas, or propane can be employed, and the transmitters are said to last indefinitely because the radiations are emitted directly from their ceramic plates without the interposition of a metallic screen that would be subject to deterioration.

Puerto Rican Industry Report

A three-page appraisal of the plastic industry in Puerto Rico is available, without cost, from the Office of Publications, Economic Development Administration of Puerto Rico, 579 Fifth Ave., New York 17, N. Y. Total annual production of plastics is reported at more than $5-million, with 39 United States companies opening manufacturing plants within the last decade.

The study notes that U. S.-affiliated plastics operations receive 100% exemption from Puerto Rican income taxes. Average hourly earnings for workers in the industry was 64¢ in June of last year, as compared with $1.80 on the mainland. Productivity ranges between 80-100% of U. S. levels, and the average net profit was reported at 13%.

The report also discusses labor availability, wage and freight rates, available materials, and market acceptance. Operations to date include injection molding, compression molding, laminating, extrusion, fabrication, and assembly.

ADM Licenses Italian Firm

Archer-Daniels-Midland Co., Minneapolis, Minn., has licensed one of Italy's largest resin manufacturing concerns, Azienda Lavorazione Colori Resine e Affine, to produce a number of ADM products on a royalty basis. The firm, known as ALCREA, is located in Milan.

Among the products to be produced by ALCREA are synthetic resins, copolymers, plasticizers, foundry core oils, and binders. ADM trade names will be used for many of the new products; however, the company will continue to produce its own line of resins.

Opens Hi-Fi Record Plant

Hi-Fidelity, Inc., has opened a plant at Playa de Ponce, Puerto Rico, for the pressing of long-playing phonograph records. The firm will employ a new process, which uses pure vinyl powder and electrically-heated molds. This eliminates preformed and compounded blanks, steam heaters, and high-pressure hydraulic presses.

The existing 5,000-square foot plant now employs 30 workers, but plans are underway for moving to a 12,000-square foot factory, and for increasing the labor force to 100. Annual production will range from 4-5 million records.

Koppers Plans Monomer Plant

Koppers International, C. A., a wholly-owned subsidiary of Koppers Co., Inc., has been awarded a contract by ANIC, a large chemical firm of Milan, Italy. Terms calls for Koppers to provide engineering data and technical assistance in the construction and operation of a styrene monomer plant in Ravenna.

ANIC will use the styrene in a GR-S synthetic rubber plant, which also is under construction in Ravenna. This will be the third styrene monomer plant in Europe using Koppers' data and assistance. Rated production is scheduled for 14,000 metric tons annually.

Names in the News

Julian A. Rogers

Julian A. Rogers has been appointed head of the manufacturing department of W. R. Grace & Co.'s high density polyethylene plant, Baton Rouge, La. He was formerly head of the ammonia department of Grace Chemical Co. **Alio J. Buselli** has been named manager of chemical research, at Grace's polymer chemicals division laboratories in Clifton, N. J. Prior to joining W. R. Grace & Co., Mr. Buselli was supervisor of polymer research and development at Air Reduction Co., Murray Hill, N. J.

John N. Kempf has been appointed manager of new product development for adhesives and coatings at Furane Plastics, Inc., Los Angeles, Calif. He previously was associated with U. S. Stoneware Co. as associate director of the research and development laboratories.

Samuel H. Tinsley has retired from the R. T. Vanderbilt Co., New York, N. Y., where he has been in development and technical sales service for more than 20 years. Prior to joining Vanderbilt in 1937, he was chief chemist for Respro, Inc., and later development and plant manager for Coated Textile Mills, Inc.

J. Gordon Hoffman, formerly general manager of Bodnar, Inc., has joined G. Felsenthal and Sons, Inc., Chicago, Ill., as eastern sales representative on edge lighted aircraft panels. Mr. Hoffman's territory will cover New York, New Jersey, and the New England States. Edward H. Yons has been appointed assistant to the president, and Hyman Shapiro has been named production manager of the firm's injection molding division.

Matthew A. Noonan has been promoted to New York district sales manager of Becco Chemical Div., Food Machinery and Chemical Corp., Buffalo, N. Y. Mr. Noonan will direct the newly-consolidated Philadelphia and New York territories. He will be assisted by Edward M. Roth, who has been appointed assistant New York manager.

Fred R. Sheldon has been appointed research laboratory manager for Becco. Prior to his promotion, he was manager of pulp and paper research and development.

Edward L. Stevens has been promoted to works manager of Spencer Chemical Co.'s Orange, Texas, plant. He formerly was production superintendent of the company's Vicksburg, Miss. facility.

Thomas J. Zito has joined the sales staff of Thiokol Chemical Corp., Trenton, N. J., as technical sales representative. He formerly was in a similar capacity at Sun Chemical Corp.

Paul Conaway

Paul Conaway has joined Foster Grant Co., Leominster, Mass., as central representative of the petrochemical division. Formerly associated with Celanese Corp.'s plastics division, he will be headquartered in Cleveland, O.

H. C. Schultze has been appointed staff assistant to the directors of the development deparment, Carbide and Carbon Chemicals Co., South Charleston, W. Va.

Vincent D. Nutile and **Joseph H. Koslowski** have been appointed technical sales representatives for the chemical division of Borden Co., New York, N. Y. Representing the coatings and adhesives department, they will work in the New England area, and be headquartered at Peabody, Mass.

George E. Meyers has been appointed New York-New Jersey technical sales representative of Rona Laboratories, Inc., Bayonne, N. J. Robert Blanc, in a similar capacity, will service the New England area.

Harry E. Knox, Jr.

Harry E. Knox, Jr., has been named general manager in charge of Acheson Dispersed Pigments Co.'s plants in Philadelphia, Pa., Orange, Tex., and Xenia, O. Howard Acheson, Jr., has been appointed works manager of the Philadelphia plant. Other promotions within the firm include: Charles R. Schroth, to sales manager; William Campbell, to technical representative in the sales department; and Dario Passigli, to leader of the process research group, research and development department.

C. F. Wolters, Jr., will retire from Diamond Alkali Co., Cleveland, O., next October. He currently is manager of the firm's Philadelphia, Pa. branch sales office. **Olin Smith,** assistant branch sales manager at the company's Chicago office, will be Mr. Wolters' successor.

Bernard B. Bowling has joined the sales staff of Seiberling Rubber Co.'s plastics division, Newcomerstown, O. He formerly was with Firestone Plastics Co.

Arthur T. Hinckley has retired from Hooker Electrochemical Co., Niagara Falls, N. Y., where he was development manager of Oldbury Products. He will be retained by the firm as a consultant.

Witold Stopowy has joined the utilities design section of the engineering department of Monsanto Chemical Co.'s plastics division, Texas City, Tex.

Thomas G. Fox has been appointed assistant director of research at Mellon Institute of Industrial Research, University of Pittsburgh, Pa.

John J. Bachner

John J. Bachner, former vice president and general manager of Chicago Molded Products Corp., Chicago, Ill., has been elected president of that firm. He succeeds the late Marcel F. Bachner.

Names in the News (Cont'd.)

Roland R. Barratt, former sales engineer specializing in reinforced plastics, has been appointed manager of the reinforced and vacuum forming division of American Plastics Corp.'s Bainbridge, N. Y. plant.

E. B. Cahn, L. E. Houck, and **B. H. Schenk** have been named vice president of Visking Co. Mr. Cahn, former general manager of the plastics division, will be vice president of that division; Mr. Houck will serve as vice president and general manager of the food casing division; and Mr. Schenck will be vice president in charge of operations.

Howard H. Leiner has been named executive chemist of Resin Research Laboratories, Inc., Newark, N. J.

Walter Dannenbaum has retired as vice president and member of the executive committee of E. I. Du Pont de Nemours & Co., Wilmington, Del. after a career of nearly 43 years. He retains his position as a member of the Du Pont board of directors.

Charles W. Proudfit

Charles W. Proudfit, former sales manager for the Hormann-Seitz Mfg. Corp., has been appointed director of sales for the resin products department of Celanese Corp. of America, New York, N. Y.

Frank R. Garner, former manager of the Kobuta, Pa. plant of Koppers Co., Inc., has been transferred to the company's Pittsburgh general offices on special assignment. Management of the Kobuta plant has been assigned to W. K. Todd.

William J. Hogg has been appointed sales manager in charge of rubber chemicals and plastics for Naugatuck Chemicals, a division of the Dominion Rubber Co., Ltd., Elmira, Ont.

Robert Ernst, formerly manager of the plastics division of Omni Products Corp. and Omni International Corp., has formed his own company Robert Ernst Associates Ltd., with offices in New York and Zurich, Switzerland.

Lloyd S. Eubanks and **Lawrence J. Krebaum** have joined the research department of Monsanto Chemical Co's plastics division at Texas City, Tex.

H. J. Deery, Jr., Dean E. Humphrey, Edward P. McLaughlin, Adam Orzechowski, Manuel Perdigao, and **Robert E. Ross** have joined the staff of the research and development laboratories of Godfrey L. Cabot, Inc., Cambridge, Mass.

Gerald L. Dennis has been appointed manager of field sales for the Naugatuck Chemical Division, United States Rubber Co. New York, N. Y. He was formerly the firm's Los Angeles district manager.

R. W. Ward, formerly plant engineer, will be in charge of all engineering and production at Nopco Chemical Co's plastics division, North Arlington, N.J. He succeeds Harry Rogers, who will be responsible for Nopco's flexible foam development program.

W. J. Canavan has been appointed assistant manager of the New Product Engineering Dep't., Bakelite Co., New York, N. Y. He was previously manager of the firm's Extrusion Materials Division.

Paul L. Kohnstamm has been elected president of H. Kohnstamm & Co., Inc., New York, N. Y. He was previously secretary of the corporation and a member of the board of directors.

David H. Conklin has been appointed managing director of Du Pont Co., Ltd. He was formerly director of sales of the petroleum chemicals division Du Pont (United Kingdom), Ltd. Mr. Conklin was succeeded to the latter post by W. Samuel Carpenter, 3rd.

J. W. Arpin has been appointed assistant plant manager of American Plastics Corp., Bainbridge, N. Y. He will serve under John A. Parsons, vice president in charge of production.

H. S. Carpenter has been appointed technical representative for the flexible packaging materials division of Bakelite Co., New York, N. Y. Located at the Clifton, N. J., district office, he is responsible for the sales and servicing of polyethylene resins and compounds for thin-film extrusion, Krene cast vinyl films for packaging, and Vinylite resin-coated paper for bottle-cap liners. His territory extends down the East Coast from Newark, N. J., to Miami, Fla. He previously served in the Cleveland district office of the company's surface coating materials division.

Robert C. Askins

Robert C. Askins has been appointed plant engineer for Reynolds Chemical Products Co., Ann Arbor, Mich. He will assist in new product development and production.

D. P. Shedd has joined Mobay Chemical Co., St. Louis, Mo., as a sales development specialist. In the newly-created post, he will provide additional liaison between the firm's sales and research departments in the development of new product applications for urethane foams and related products. He formerly was a technical sales specialist for Monsanto Chemical Co., which he joined in 1946.

G. G. D'Andrea has been appointed director of product development engineering for Durable Formed Products, Inc., New York, N. Y. In the new post, he will supervise the firm's engineering department and cooperate with the sales department by offering manufacturing design service.

E. L. Mears has been appointed to the newly-created position of general manager of the Container and Chemical Specialties Division of Dewey & Almy Chemical Co. Division, W. R. Grace & Co., Cambridge, Mass. He formerly was manager of the firm's central services division. Mr. Mears has been with Dewey & Almy since his graduation from M.I.T. in 1930.

H. B. Smith, Jr., has been named sales engineer in the Middle Atlantic area for the process equipment division of Rodney Hunt Machine Co., Orange, Mass. He will serve customers in Southern New Jersey, Eastern Pennsylvania, Delaware, Maryland, and Northern Virginia from offices in Chester, Pa. Holder of a B.S. in chemical engineering, he has been with Foster Wheeler Corp., Downingtown Iron Works, and United Engineers & Constructors.

D. L. Seeber, W. E. Ford, Jr., and **D. L. Davidson** have been named sales engineering specialists on adhesives, coatings, and sealers by Raybestos-Manhattan, Inc., Bridgeport, Conn. Mr. Seeber will have headquarters in Bridgeport, and will cover Northeastern United States. Mr. Ford will cover Ohio, Western Pennsylvania, and Western New York, with headquarters in Cleveland. Mr. Davidson, headquartered in Detroit, will cover Michigan and Northwestern Ohio.

F. W. Silva

F. W. Silva has been appointed technical service manager for associate company relations of B. F. Goodrich Chemical Co., Cleveland, O. He will report to the director of associate company relations, **M. W. Larson,** and provide technical service to BFG affiliates in England, Brazil, Mexico, and Japan. Holder of a B.S. in chemical engineering from Purdue University, he joined Goodrich in 1939. After various posts with the company, he most previously was director of the PVC plant of Geon do Brasil.

A. R. Pollack has been named manager of the reinforced plastics and foam department of Strick Plastics Corp., Perkasie, Pa. He previously was a plastics engineer in the Victor Division of Radio Corp. of America, and holds a degree in chemical engineering from Syracuse University.

J. G. Shirley, Jr., has joined the methods and procedures section of Monsanto Chemical Co.'s plastics division at Springfield, Mass. He previously served for four years with Premoid Corp.

J. J. Bachner was re-elected president and general manager of Chicago Molded Products Corp., Chicago, Ill., at the annual stockholders meeting last month. Other officers re-elected were **E. F. Bachner,** chairman; **L. H. Bachner,** vice president and treasurer; **L. W. Anderson, E. F. Bachner, Jr.,** and **J. E. Johnston,** vice presidents; and **L. C. Andrews,** secretary and controller.

Bakelite Co., New York, N. Y., has announced the following appointments: **L. D. Burnett, Jr.,** as assistant manager of the film and sheeting division; **M. M. Suba,** as manager of the extrusion materials division; **W. B. Lyon,** as a technical service representative for the molding materials division in the Chicago office; and **Charles Lowe,** as a technical representative for the extrusion materials division in the Hartford, Conn., office. Mr. Burnett joined Bakelite in 1946, and has been with the firm's flexible packaging division in the eastern area. In his new position, he will assist **J. W. McLaughlin,** manager of the film and sheeting division. A graduate of Rutgers University, Mr. Suba joined Bakelite in 1933 as a technical representative for the extrusion materials division in the Hartford office. In his new post, he will be responsible for sales of Bakelite vinyl, polyethylene, and polystyrene extrusion materials. Holder of a B.S. degree in chemical engineering, Mr. Lyon joined Bakelite in 1955, served in the Army, and returned to the company late last year. In his new assignment, he will be responsible for sales and customer service of all Bakelite molding materials in the territory that includes Chicago and Gary, Ind. Mr. Lowe joined Bakelite in 1955 after serving with the Navy. In his new position, he will be responsible for sales and customer service of Bakelite polyethylene, vinyl, polystyrene, and fluorothene extrusion materials in a territory that includes Portland, Bangor, and the rest of Maine; all of Rhode Island; Boston, Springfield, and Worcester, Mass.; and Hartford, Conn.

D. M. Nielsen and **R. H. Rehm** have been appointed assistant district managers of the New York and Newark district sales offices, respectively, by Union Carbide Chemicals Co., New York, N. Y. Mr. Nielsen joined the firm in 1947 and, prior to his promotion, was a technical representative in the New York sales office. Mr. Rehm came with Carbide in 1946, and was a representative in the Buffalo district sales office. Two reassignments of technical representatives have been made by Carbide's sales department: **W. P. Emerson,** from office to field sales in the Atlanta district; and **M. H. Mackay,** from the Chicago district to the Newark district.

OBITUARY

Harry H. Kugel

Harry H. Kugel, 60, president of Nosco Plastics, Inc., Erie, Pa., died February 11 at Delray Beach, Fla., where he had gone to convalesce from a short illness.

Mr Kugel had been active in many civic and social endeavors, and held positions in several other companies. At the time of his death, he was a director of the Union Bank of Erie. He is survived by his wife, Ruth Schneider Kugel, two daughters, a brother, Ruber G. Kugel, and three sisters.

Douglas Woodruff

Douglas Woodruff, chairman of the board and a former president of Auburn Button Works, Inc., died April 9. He was born in Auburn, N. Y., on January 6, 1882, and received his early education in that city. Mr. Woodruff attended Hotchkiss School, and was graduated from Yale University.

Mr. Woodruff was one of the original members of Plastics Pioneers, The Society of the Plastics Industry. He served as director of the Auburn Trust Co., and the Diocesan Foundation of the Episcopal Church.

Services were held on April 13, followed by interment in Fort Hill Cemetery, Auburn, N. Y. Mr. Woodruff is survived by his wife Mildred Lane Woodruff; two sons, John and Douglas, Jr.; and a daughter, Elizabeth Woodruff Lederer.

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New Materials

Write item numbers on Readers' Service Card to obtain more information.

Silicon Chemical Intermediates

Four, monomeric, silicon chemical intermediates which can be reacted with organic chemicals have been introduced by Union Carbide Corp.'s silicones division. Designated Organo Functional Silanes, the materials carry an amino or carbethoxy radical attached to the terminal carbon of the silicon-carbon side chain.

The four currently offered are gamma-aminopropyltriethoxysilane, delta-aminobutylmethyldiethoxysilane, beta-carbethoxyethyltriethoxysilane, and betacarbethoxyethylmethyldiethoxysilane. They can undergo amine reactions with acids, esters, aldehydes, ketones, halides, isocyanates, carbon disulfide, cyanuric chloride, sulfonyl chloride, and naphthylamine. Silane reactions include hydrolysis, transesterification, and co-hydrolysis; carbethoxyethoxy silane reactions include saponification with water and alkali, with alcohols, amines, and excess water, as well as co-hydrolysis.

Among the applications for the silanes are the modifications of lubricants, emulsifiers, anti-static agents, sizing and finishing agents, synthetic resins, and flame retarders. One interesting use involves the finishing of glass cloth with gamma-aminopropyltriethoxysilane, which reportedly gives superior laminates with melamine, phenolic, and epoxy resin systems. Plastic sections of this type have extensive use in guided missiles and other military applications.

Readers' Service Item M-1

Carbon Black Dispersions

Two colloidal dispersions of carbon black, recently introduced by Columbian Carbon Co., are said to offer special advantages and economies to manufacturers of high-grade acrylic and nitrocellulose lacquers. Named Co-Acrylateblak NC-1401 and Coblac 405, respectively, the materials offer high carbon-black loading which, in turn, produces high jetness and mirror-like gloss.

Co-Acrylateblak NC-1401 contains 22% by weight of Neo Spectra Mark II carbon black chips, 29.5% acrylic resin, 29.5% half-second nitrocellulose, and 19% plasticizer. A clear solution is made of all the ingredients except the chips; the latter are added with continuous agitation. Complete solution is achieved in a manner of minutes.

Coblac 405 contains 22% by weight of Neo Spectra chips, 59% half-second nitrocellulose, and 19% dibutyl phthalate. The method of mixing is the same as outlined above; however, care must be taken to control viscosity. The use of straight-solvent solutions should be avoided if at all possible.

Readers' Service Item M-2

High-Density Polyethylene

A higher-density (0.938) polyethylene material, produced by the conventional high-pressure type process, has been introduced by Spencer Chemical Co. Trade named Poly-Eth Hi-D 2504, the material is intended for the manufacture of film that will withstand temperatures to 240° F.

The film is said to possess a number of advantages over standard polyethylene films. It is 2½ times stiffer, less than one-half as permeable to gases and water vapor, and at least three times more greaseproof. Other features include high clarity, better gloss, and greater yield strength.

Properties for a 1.5-mil, lay-flat tubing produced from High-D 2504 are reported as follows:

Specific gravity	0.938
Melt index, gms./10 min.	1
Softening point, Vicat, °F.	235
Ultimate tensile strength, psi.,	
machine direction	3,050
Transverse direction	3,225
Tensile strength at yield, psi.,	
machine direction	1,900
Transverse direction	2,000
Ultimate elongation, %,	
machine direction	455
Transverse direction	600
Impact strength, psi.	1,900
Coefficient of friction	0.6
Block, gms.	Nil
Carbon dioxide permeability, cu. ft./sq. ft./mil/24 hrs./psi.	6.67 x 10-3
Oxygen permeability, cu. ft./sq.ft./mil/24 hrs./psi.	1.92 x 10-3
Water vapor transmission, 100% RH, 100°F., gms/24 hrs./100 sq. in.	0.242

Readers' Service Item M-3

Mechanically-Interlocked Felts

Ten mechanically-interlocked, synthetic-fiber belts, called Feutrons, have been introduced by American Felt Co. Possessing the desirable physical characteristics of wool felts, the new materials also offer the exceptional chemical and thermal properties of synthetic fibers, including nylon, Orlon, Dacron, Acrilan, Dynel, and Arnel.

Among the specialized applications for Feutron felts are high-temperature bearing seals, dry and wet filtration, wicks, and as reinforcements or overlays in low-pressure plastic laminates. Advantages offered in plastic laminates include smooth surface, three-dimensional strength properties, uniform weight and thickness, good drape and tailoring properties, good resin pick-up, good resin-fiber adhesion, high strength, and high elongation.

Polyester fiber felts weighing 10 ounces per square yard are recommended for radar parts, radomes, and etched circuits because of their low wet-electrical dissipation and loss factor, low dielectric constant, and high electrical-insulation resistance factor. Acrylic fiber felts weighing five ounces per yard are recommended as overlays in fibrous-glass mat bodies, where they eliminate the need for a gel coat, provide a smooth surface, and afford chemical resistance.

Orlon felts are provided in widths of 63 and 72 inches. Weight tolerances range from 0.68-1.5 pounds per square yard, thicknesses from 0.045-0.125 inch, and densities from 25-32. Breaking strengths for two-inch widths range from 130-220 pounds; elongation at rupture varies from 18-60%; and Mullen bursting strength ranges from 400-550 psi.

Dacron felts are available in the same widths, with weight tolerances of 0.62-1.5 pounds per square yard, thicknesses of 0.08-0.25 inch, elongations of 22-150% at rupture, and Mullen bursting strengths of 500-550 psi. Breaking strength for a two-inch specimen is 40-350 pounds. The other Feutron felts have specialized uses, and fit within the above-mentioned ranges.

Readers' Service Item M-4

Lead-Plastic Compounds

Two, lead-filled plastic compounds, used for casting homogeneous shields against radioactivity, or for use as high-density molding compounds, have been introduced by Telectro Industries Corp. Both are available as pour materials, or as custom-finished pieces.

Leadolene contains 95% lead and 5% polyethylene by weight, but the exact composition can be varied in accordance with specific requirements. Having a specific gravity of seven grams per cubic centimeter, the compound can be cast into intricate shapes, including those with hollow portions and tapered walls. The finished surface is smooth, resistant to chemical action, and resembles that of the polyethylenes used for plastic containers.

Leadolene is bonded readily to glass and metals; however, Leadolene pieces can be joined only by melting the joining edges together, or by pouring the liquid material between interlocking members. It melts at 220° F. into a low-viscosity liquid, but is not soluble in most solvents. Cast pieces can be remelted and cast again.

with no loss of materials because of oxidation.

Leadcoat contains 95% lead and 5% epoxy resin by weight; however, the proportions can be varied to produce hardnesses from semi-rubber to cast aluminum. Having a density of 6.6 grams per cubic centimeter, the compound is harder than pure lead and has a greater structural rigidity. It can be cast, using inexpensive molds, into a variety of shapes with 0.5-mil tolerances. The surface requires no finishing, and is inert to oxidation and corrosive contamination.

Leadcoat's low and uniform shrinkage (about 0.2%) makes it possible to cast a wheel around a steel shaft with a concentricity of 0.0002-inch. The compound sets in about one hour after the addition of catalyst; in about 10-20 minutes at temperatures of 120-140° F.

Readers' Service Item M-5

Acetate Molding Powder Line

A complete line of cellulose acetate powders, designed for high-speed injection molding and extrusion, is available from Poly-Cell Plastics Co. Among the features claimed for the line are low cost, durability, batch consistency, color fastness, and impact resistance.

Groups I, II, and III are available in all flows, and as clear, colored transparent, general opaque, translucent, special opaque, and black colors. Groups IV and V, extrusion and injection molding grades, are marketed in medium and high concentrations, respectively, both in pearl colors, and the latter also in tinseled clear.

Readers' Service Item M-6

Polyether-Based Prepolymers

A series of two-component, polyether-based prepolymer systems for making flexible urethane foams has been introduced by Isocyanate Products, Inc. Called Isofoam L, the formulations were designed specifically to meet the requirements of the cushioning industry. They feature low compression-set, excellent aging and chemical resistance, high resilience, and low cost.

A typical formulation calls for 100 parts of Isofoam L-31 and five parts of Catalyst L-31. The components are mixed until homogeneous and foaming action can be detected. The mixture is poured into a mold which has been preheated to 120° F., and coated with a paste-wax release agent. When expansion has ceased, the foam is cured for one hour at 200° F., under conditions of 50-100% humidity.

Shelf life of unopened containers is at least three months when stored at temperatures under 100° F. Adequate ventilation should be provided during mixing, because traces of toluene 2,4 diisocyanate are given off in vapor form. Direct contact with any part of the body should be avoided.

Physical properties of Isofoam L-31 are reported as follows:

Viscosity @ 25° C., cps.	4,000-6,000
Density, lbs./cu. ft.	3
Tensile strength, psi.	12.4
Elongation, %	120
Compression set, 22 hrs. @ 70° C., ASTM method B, %	6.7
Compression/deflection, 10%, psi.	0.31
25%, psi.	0.39
50%, psi.	0.57

Readers' Service Item M-7

Phthalate-Type Plasticizer

A monomeric phthalate used as a primary plasticizer for vinyl resins has been introduced by Carbide Chemicals Co. Designated Flexol 380, the material is said to surpass all other monomeric plasticizers in its resistance to nitrocellulose-lacquer marring. Calendered vinyl sheeting, plasticized with 50 parts of Flexol 380 per hundred parts of resin showed no signs of marring after direct exposure to nitrocellulose lacquer for 24 hours at 140° F.

The new plasticizer is reported to compare favorably with other general-purpose phthalates in heat and light stability, resistance to water and oil

VANSTAY Z

zinc bearing chelator for PVC resins imparts outstanding clarity, stability and resistance to sulfur staining when used as recommended with other VANSTAYS in many vinyl products.

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extraction, and low temperature properties. Suggested applications include lamp and clock cords, doll parts, furniture and upholstery, handbags, outerwear jackets, tablecloths, and sponges.

Data obtained on vinyl compounds containing 40 parts Flexol 380 per 100 follows:

Hardness, Durometer "A"	83
Tensile strength, psi	3,600
Elongation, %	271
At 1,000 psi., %	18
Stiffness @ 23° C., psi.	3,800
Brittle point, °C.	—14
Volatile loss (4-mil film, 24 hrs. @ 70°C.) %	2
Water extraction, 24 hrs. @ 70°C., %	1
Oil extraction at 50° C., K value	0.7
Plasticizer removal, rub-off @ 50°C., K value	1
Lacquer marring, 24 hrs. @ 40°C., % softening	<10
Volume resistivity @ 50°C., megohm-cm x 10^{-6}	24

Readers' Service Item M-8

Synthetic Paraffin Wax

A hard, synthetic-paraffin wax formed by the Fischer-Tropsch synthesis, and mixable in all proportions with polyethylene, has been introduced by Moore & Munger. Called Paraflint, the wax's combination of properties suggests its use as a detackifier, lubricant, hardening or stiffening agent, and as a finishing aid for polyethylenes and PVC.

Paraflint is essentially a mixture of saturated, straight-chain paraffin hydrocarbons having an average molecular weight of 750. It resembles the conventional, petroleum-derived paraffin waxes in appearance; being white in color, brittle, and of low viscosity when melted. It differs from them, however, in its higher melting point (214° F.), finer crystal size, and greater hardness. Scuff and blocking resistance, therefore, are much higher than conventional paraffins; coefficient of friction is much lower.

An addition of 10-20% by weight of Paraflint to conventional polyethylenes is said to yield favorable results in the production of bottles and similar containers. Hardness and strength are improved, as are resistance to water vapor, perfume and gas penetration. Increased hardness and melt index permits the injection molding of thinner-walled containers without reducing the impact and tensile qualities. Paraflint wax also lubricates extrusion nozzles, thereby eliminating adherence difficulties.

Polyethylenes with a molecular weight under 30,000 are stirred into the wax at approximately 302° F. for about 30 minutes. In the case of new, high density polyethylenes, the wax must tbe heated and worked into the polyethylene at approximately the same temperatures.

Paraflint properties are reported as follows:

Congealing point, °F.	204
Needle penetration @ 77° F.	1.5
Consistometer hardness, Abraham units @ 110° F.	65.4
At 130° F.	47.9
At 150° F.	33.9
At 160° F.	24.1
Oil content, MIBK, %	1
Odor, O-4 scale	2
Neutralization, Saponification, and Bromine values	Nil

Readers' Service Item M-9

Polyamide Extrusion Compound

A polycaprolactam-type polyamide, Plaskon Nylon 8201, has been introduced by Allied Chemical & Dye Corp.'s Barrett division. Especially formulated for extrusion and blow molding, the material reportedly is characterized by a low-moisture content, wide temperature range, and high molten viscosity.

High viscosity, and high-pressure capacity of the end product, make the compound particularly suitable for the blow-molding of bottles. As a laminate, Plaskon Nylon 8201 adds scuff and abrasion resistance. The material is packed in an inert-gas atmosphere, which eliminates the need for special drying.

Properties are reported as follows:

Tensile strength, psi.	8,500
Ultimate, psi.	12,000
Elongation, %	300
Modulus of elasticity in tension, psi.	340,000
Compressive strength, yield point, psi.	11,000
Stress at 1% deformation, psi.	3,000
Impact strength, Izod, ft. lbs./in. of notch	1.2
Flexural strength, psi.	5,500
Deformation under load, 2,000 psi., 122° F., %	1.7
Heat-distortion point, °F.	145
Hardness, Rockwell R.	118
Bulk factor	1.6
Specific gravity	1.13
Water absorption, %	1.6
Dielectric strength, volts/mil, short time	420
Step-by-step	370
Volume resistivity, ohm-cm. x 10^{12}	4.5
Coefficient of linear expansion/°F.	4.6 x 10^{-5}
Specific heat	0.4
Thermal conductivity, Btu/hr.	1.7
Flow temperature, °F.	419

Readers' Service Item M-10

Versatile Color Concentrate

A versatile color concentrate for silk screening and roller coating of all plastics, except cellulose acetates, has been introduced by Logo, Inc. Called RV-300, the material is said to serve equally well on coated papers, hardboards, and leathers.

Screening and roll-on inks are made from RV-300 by the addition of a clear base and thinners until the desired gloss and viscosity are obtained. The following standard colors are available for color shading and matching: titanium white, tinting black, jet black, lemon yellow, phthalocyanine green, iron blue, ultramarine blue, molybdate orange, iron red, watchung red, and maroon. Gold and aluminum colors can be formulated.

RV-300 can be used as an air-dry finish on thermosetting plastics, and can be used without a prime coat on non-ferrous metals. The coating will be tack-free in approximately 15 minutes and pack-dry in 2-3 hours. Force-drying may be used to speed drying time, and to improve adhesion to ferrous metals.

RV-300 colors will pass refrigeration specifications, as well as the cross-hatch Scotch-Tape test. Humidity resistance exceeds 1,000 hours at 110° F. and 100% humidity. A 50-50 mixture of lard and oleic acid does not affect the finish after 100 hours exposure at room temperature, nor does a 2% soap solution after 24 hours at 110° F.

Readers' Service Item M-11

Two Epoxy Formulations

Two new resins have been added to the Maraset line of epoxies produced by Marblette Corp. Maraset 636 is a tough, flexible compound with high dimensional stability, resistance to heat and chemicals, excellent recovery characteristics, and good adhesion to many materials. Applications include potting and sealing, encapsulating of electronic components, gasketing, casting, and facing of drop-hammer dies.

Suggested formulations call for 100 parts resin 636A, 10 parts Hardener 30, and 100 or 150 parts resin 636B. Following blending, the mixture should be heated to 212° F., and stirred until a clear mixture is formed. A three-hour cure at 212° F. is recommended. Average physical properties for the part containing 150 parts resin 636B include an elongation of 200%, a tensile strength of 2,600 psi., and a Shore "A" durometer hardness of 50-60. A higher hardness value of 90 is found for the parts using only 100 parts resin 636B, and the impact strength is 28 foot-pounds per inch, using the unnotched Izod method.

Maraset 650 is a high-impact casting resin, available in transparent, opaque white, and blue types. Combined with Hardener 25, the resin produces a low-exotherm epoxy system which allows the production of bubble-free, strain-free castings of low-specific gravity. Pot life is approximately 8-16 hours at room temperature.

The recommended formulation calls for 80% by weight of resin to 20% hardener. After pouring into the mold the resin turns milky, but will clear before cure. Cure can be effected at room temperature or 180° F. for 16 hours. About 100 cubic inches can be filled with 3.7 pounds of resin.

Properties are reported as follows:

Hardness, Rockwell "M"	90-100
Specific gravity	1.05
Impact strength, unnotched Izod, ft.lbs.	7
Elongation, %	3-5
Compressive strength, yield, psi.	20,000
Ultimate, psi.	40,000
Shrinkage, %	0.5
Heat distortion point, °F.	180

Readers' Service Item M-12

New Equipment

Write item numbers on Readers' Service Card to obtain more information.

Stanley Surform plane and file tool.

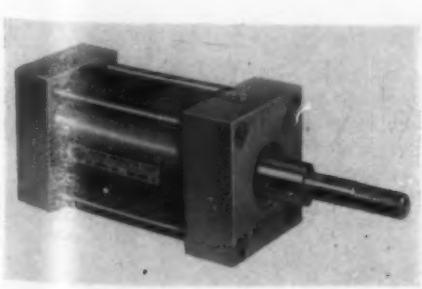
Forming and Finishing Tool

A tool for forming and finishing all materials up to the hardness of mild steel, has been placed on the market by Stanley Tools, a division of Stanley Works. Called the Surform, the tool is available in two models: one shaped and used like a hand plane; the other shaped and used like a rasp.

The cutting component is a Sheffield steel unit having more than 450 separate, razor-sharp blades. Each cutting edge has a 35-degree angle, plus a semi-circular throat through which chips and shavings pass. In effect, each blade functions as a miniature block plane. The three-ounce cutting strip can be replaced when worn, and is interchangeable for both models.

The plane-type Surform is 10 inches long and 1¼ inches wide. The highest point of the rear handle is 5⅛ inches above the base. The file-type Surform is 1-11/16 inches wide, and 16⅜ inches in over-all length. Plane and file weigh 10 and eight ounces, respectively, and have a slightly outward curvature.

Readers' Service Item E-1



Alton Model E heavy-thrust cylinder.

Air-Hydraulic Cylinder

A double-acting cylinder with elliptical, non-rotating piston rod has been introduced by Alkon Products Corp. Designated Model E, the cylinder is intended for operations requiring register of piston rod without cumbersome external guides. It reportedly permits a heavier thrust than the standard Alkon Model D cylinders.

An adjustable bushing permits compliance with different rod-fit requirements, in addition to compensating for wear. The new cylinder is rated for 250 psi. air pressure or 500 psi. water or oil pressure. It is available in 1¾- and 2½-inch bores, with all standard interchangeable mounts. Length of the cylinder is approximately 8¼ inches, less the stroke. Stock strokes, non-cushioned, range from one through 20 inches in increments of one inch. Maximum stroke is 19 inches for the single-cushioned cylinder, and 18 inches for the double-cushioned cylinder.

Readers' Service Item E-2

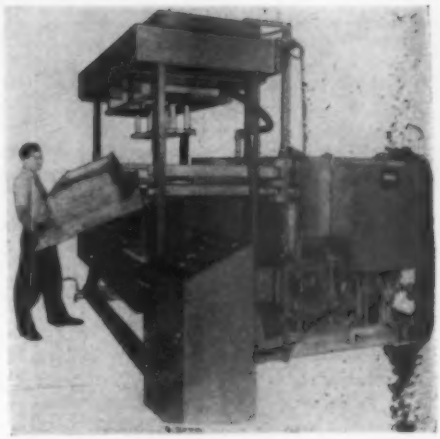
Adaptable Forming Press

A new forming press for fabricating difficult shapes and material thicknesses is available from Comet Industries. Called the Star, the machine incorporates the following techniques: snap-back forming, pressure forming, mechanical forming, vacuum forming, and trimming.

The basic operation features automatic withdrawal of a super-heated plastic sheet from an enclosed oven. Even heating on both sides of the sheet reduces cycle time to an absolute minimum. The sheet is clamped securely between two platens, which are driven electrically and controlled individually to and from the forming area.

The Star is marketed in four standard sizes, with mold areas ranging from 36 by 48 inches to 60 by 96 inches. Machine height is 106 inches; length, 100 inches; and width (with oven), 106 inches. Special adaptations are available.

The stroke is 27 inches for the upper platen, and 34 inches for the lower platen; both are supplied with the central vacuum system. Counteracting, the platens provide for plug assist of hold-back directing control on the plastic sheet during forming. Each platen is capable of carrying a mold or helper, and performs a complete fabricating operation. Vacuum may



Star forming press with 48 by 72-inch mold.

be applied through either or both platens simultaneously, depending upon the technique desired.

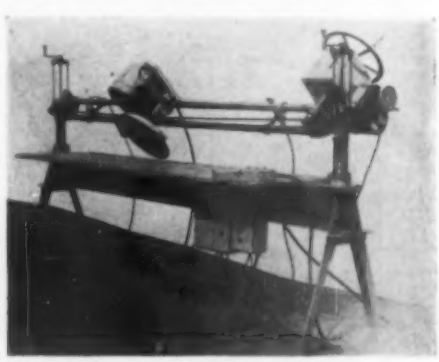
Control panel of the Star is portable, and can be moved to any location. Loading operations can be done either manually or by automatic machines such as extruders, etc. The Star requires an air pressure of 100 psi., and its automatic cycling operations are pre-set in special timers. The oven is supplied with either 220- or 440-volt heaters, providing both top and bottom heating, or it can be supplied with either gas or oil heating.

Readers' Service Item E-3

Improved Panel Saws

All panel saws produced by Hendrick Mfg. Corp. now incorporate a newly-designed saw carriage of greater strength, which also is provided with blade-tracking adjustment. This Model C carriage is mounted on Fafnir self-aligning, pillow-block ball bearings, which are locked to the shaft with eccentric collars.

Heeling on the outrun of the blade is corrected by adjusting the position of the bearings at the pulley end. The carriage is cast aluminum of block design. Renewable bronze bushings ensure smooth run along the rails. Interchangeable with former models, the new carriage is supplied with a 14-inch blade guard. Positive,



Hendrick Panel Saw with improved Model C carriage.

four-point motor mounting and belt-tension adjustment is provided for NEMA frame motors 56, 66, 182, and 184.

A dial-indicator bearing on the blade instantly shows the required adjustments when the blade is advanced and retracted. Since the blade can be held to very close tracking limits, the Model C carriage is essential with such critical cutting operations as counter-tops and the like.

Readers' Service Item E-4

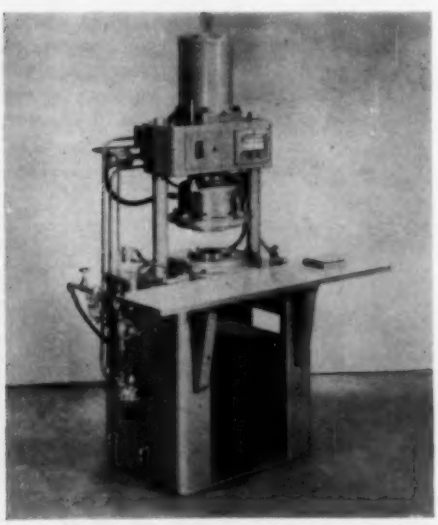
Plastic Draw & Trim Machine

An electrically-heated machine for drawing and trimming thermoplastic box covers in one operation has been introduced by Taber Instrument Corp. Designated the Thermatic Drawpress, Model 146, the unit turns out either round and oval covers, having a maximum diameter of 8½ inches, and a maximum draw of one inch.

Standard equipment includes electric heaters, an air-pressure filter, air regulators and a pyrometer indicator-controller which automatically maintains die temperatures within close limits. A detachable thermocouple is inserted in the lower die holder, and connects with the aforementioned pyrometer.

The press is actuated by 60-100 psi. compressed air from factory supply lines. Two individually-regulated air tanks furnish "pneumatic-spring pressure," which prevents wrinkling of the plastic blank as it is being drawn. Exhaust air from the main cylinder cools the punch holder which, in turn, keeps the punch relatively cool during continuous operation.

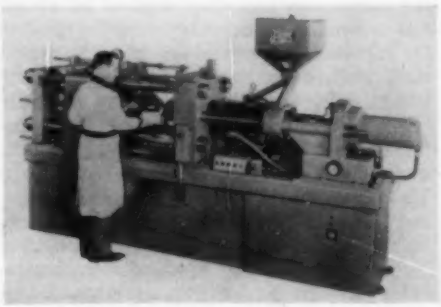
To operate the press, both hands must depress and hold down the dual actuating switches. Upon release, the finished part is blown through the lower die into a chute which leads to the receiving container. The upper die then returns to its original position.



Thermatic drawpress for forming plastic lids.

Height of the unit is 74 inches, and the floor space required measures 30 by 33 inches. Net weight approximates 1,200 pounds. Production rate ranges from 10-20 pieces per minute, and requires the continuous output of a five-hp. compressor at 60-80 psi. A 10-hp. compressor is needed for a 3-4 second cycle. Trim can be removed manually, or with a 146-20 blow-off attachment.

Readers' Service Item E-5



Lewis' Model 616-PP-12 injection molding machine.

Injection Molding Machine

Data is now available on Lewis Welding & Engineering Corp.'s Model 616-PP-12 plastics injection molding machine. Featuring a pre-plasticizer mechanism, it is reported to be the first production machine capable of molding low-pressure, linear-type polyethylenes, as well as other types of thermoplastics.

The pre-plasticizing unit permits the use of injection pressures 60-70% lower than those normally required, and the nozzle shut-off valve eliminates the necessity for pressure-holding after injection. Since the heating-chamber temperature averages only 45° F. higher than the temperature of the plastic on ejection, the machine's normal operating cycle can be interrupted without burning or changing the viscosity of the material in the heating chamber.

Specifications are reported as follows:

Shot capacity in polystyrene, oz.	22
Shot size, max., cu. in.	36
Plasticizing capacity, lbs./hr.	145
Injection plunger diameter, in.	2.25
Area, sq. in.	4
Pressure on material, psi.	25,000
Injection stroke, in.	9.5
Injection rate, cu. in./sec.	9.2
Heating cylinder, total watts	18,600
Mold thickness, max., in.	16
Minimum, in.	6
Platen & die-plate size, in.	24
Distance between strain rods, in.	14.75
Clamp strain rods, no.	4
Diameter, in.	3.25
Mold clamping pressure, tons	200
Hopper capacity, lbs.	100
Hydraulic pressure, psi	2,000
Hydraulic pump, combined volume, gal./min.	33
Oil reservoir capacity, gals.	100
Motor, hp.	25
Length, in.	151
Width, in.	96
Height, in.	96
Weight, lbs.	14,000
Dry cycles/sr.	360

The preplasticizer unit has a separate power source. Its hydraulic system has an operating pressure of 2,000 psi., and a hydraulic-pump combined volume of 22 gallons per minute. Its oil-reservoir capacity is 60 gallons. A 20-hp. motor powers the unit, and is capable of speeds up to 1,200 rpms.

Readers' Service Item E-6

Re-Designed Scrap Grinder

A re-designed version of the M-4 all-purpose Molded Plastic Scrap Grinder has been introduced by Injection Molders Supply Co. Lower in height than the conventional grinder and with a longer hopper, the new model incorporates a throat-clearance bar which makes it impossible for the operator to reach into the hopper and receive a serious injury. This is accomplished without restricting the throat opening.

Snap-in screens are easily removed for cleaning, and the hopper hinges eliminate the need for lifting the entire unit to clean up during color changes. Specifications are reported as follows:

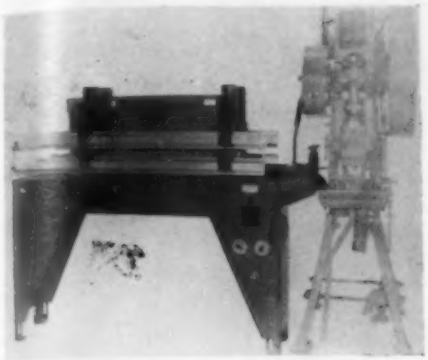
Height, in.	54
Floor space required, in.	30 x 18
Throat opening, in.	5.375 x 8.5
Motor, hp.	2
Rpm.	1,750
Rotor speed, rpm.	500
Screen sizes, std., in.	¼ and 5/16
Rotating knives	2
Stationary knives	2
Capacity per hour, styrene, lbs.	150

IMS' re-designed plastic scrap grinder.

Readers' Service Item E-7

Plastic Strip-Stock Feeder

A machine for feeding laminated plastic and fiber strip-stock automatically into any standard blanking press at controlled temperatures up to 300° F. has been developed by Technical Design & Development Co., Inc. Called the Strip Stock Feeding Machine, it handles laminates of 0.02-0.125-inch thickness; lengths of 16 inches to four feet; widths of ½-4½ inches; and feeds lengths of 0-3 inches per stroke.



Automatic feeder for plastic strip stock.

An electric heater, controlled by a thermostat, maintains the stock at the proper blanking temperature. Constructed of cast iron, it preserves dimensional stability and eliminates warping. Preheaters are recommended, however, for the heavier gages, and for long, fast feeds.

The strip stock is loaded into a magazine, where it rests on a special feed belt synchronized with the press through a crank arm to an indexing roll feed. As the bottom strip leaves the machine, the strip above falls into place. Positive butting of the ends reduces partially-blanked pieces to a minimum. The feed is lagged to the floor to maintain alignment of the feed tracks with the press die. Leg pads permit adjustment of the feed height to the height of the die feed line.

Dimensions of the unit are as follows: length, 76 inches; width, 18 inches; and height, 53 inches.

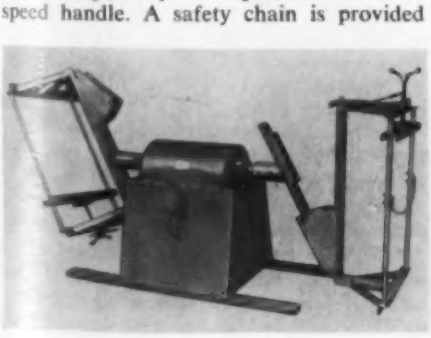
Readers' Service Item E-8

Floor-Loading Drum Tumbler

A heavy-duty, twin-drum tumbler for blending dry-colored materials and mixing phenolics where fines have separated in shipment has been placed on the market by Rainco Mfg., Inc. Featuring floor-level loading and an extremely rugged frame, the tumbler can accommodate up to 300 pounds in each drum.

The drum holders will accomodate any size drum up to 24 inches in diameter, and up to 33 inches in height. Drums are clamped by a top screw with a speed handle. A safety chain is provided at the center, with adjustable stops at the base of the drum for preventing side movement. The entire unit requires an operating floor space of approximately five by 10 feet.

The machine has a 2-7/16 B3X turned and ground main shaft with self-aligning ball bearings. Power is provided by a 220 to 440-volt, ¾-hp. master gear motor with 30:1 worm gear reduction. This reputedly eliminates the danger of shaft turning during loading. The unit is wired with a reversing-type drum switch. A drop-leaf arrangement, which can be supplied in place of a solid arm, eliminates the problem of hoisting a loaded drum onto the cradle.



Rainco twin-drum tumbler.

Readers' Service Item E-9

Detroit M-11 router bits for plastics.

Wear-Resistant Router Bits

Straight and spiral-fluted router bits of wear-resistant M-11 chrom-cobalt steel are now available from Detroit Tap & Tool Co. Designed for tooling such plastic structural materials as rigid panels, furniture components, patterns, housings, the router bits have straight shanks and either single or double ends.

The straight-fluted bits range from 1/16-2 inches in diameter; the spiral-fluted bits from ⅛-¾ inch. Spiral bits are available also with inverted taper shank, single- or double-fluted, in 5/16- and 21/64-inch sizes.

Readers' Service Item E-10

Vest-Pocket Hardness Gage

A small, hardness gage for rubber and plastics reading in ASTM Durometer units has been introduced by W. F. Orth. Called the Rex Model A, the gage has a hardened-steel indentor which pushes up the vernier runner by direct contact. The runner is held by friction, and the instrument can be removed for readings on other sections.

The vernier reads directly to five points, and permits interpolation to about two points with average vision. A magnifier permits more accurate readings. The gage's operation resembles that of a tire gage. Total range is 0.1-inch, and the 100 divisions on the scale permit readings of 0.001-inch or one durometer point. Accuracy is ±0.001. The gage weighs 1½ ounces, and can be carried in a vest pocket.

Orth's Rex Model A hardness gage.

Readers' Service Item E-11

FINELY GROUND

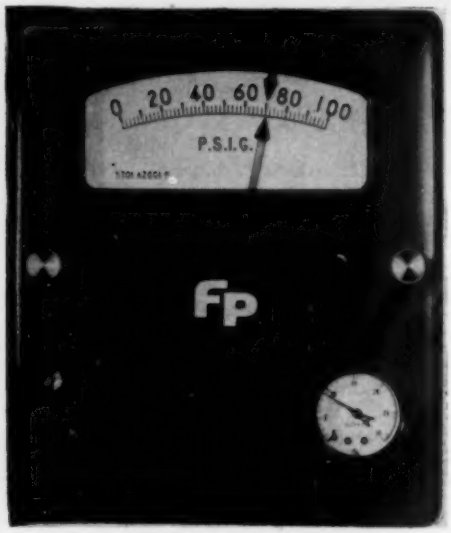
MICA FILLERS

Increased strength...high impact resistance...compatible with all resins . . . and best thermal and electrical properties of any mineral filler.

The English Mica Co.
STERLING BUILDING, STAMFORD, CONN.

New Products

Write item numbers on Readers' Service Card to obtain more information.



Pressure-computing instrument features reinforced-plastic housing.

Plastic Instrument Housings

A line of small-sized instruments for indicating, transmitting, and controlling pressure and temperature has been introduced by Fischer & Porter Co. Called the Series 1450, the instruments are housed in fibrous glass-reinforced polyester cases, and are idealy suited for use outdoors or in corrosive atmospheres.

Temperature range for the 1450 Series is minus 400° F. to plus 1,000° F. The pressure range is from 30 inches mercury vacuum to 5,000 psi. All exposed parts, not of reinforced plastic, are of 316 stainless steel. PVC gasketing around the door and input lines seals out moisture and dust. The instruments are adapted to surface-, panel-, or pipe mounting.

Readers' Service Item P-1

Reinforced Plastic Sheets

Flat, translucent sheets of fibrous glass-reinforced polyesters have been introduced by Strick Plastics Corp. Called Glazor, the sheets range in size from standard sash to 48 by 96 inches. They are press-molded from three-ounce mat for greater rigidity.

Reportedly twice as strong as ordinary corrugated sheets, Glazor will support 100 pounds per square foot on a four-foot span. It cannot be damaged by welding sparks, burning cinders, etc., and can be made completely flame-resistant by the addition of self-extinguishing resin.

Glazor can be installed with conventional wood-working tools, and can be used as roofing or siding. Available colors are ermine white, daylight green, natural, light blue, and forest green.

Readers' Service Item P-2

Globe-Type Butyrate Valve

A non-rising stem, globe-type valve made of Eastman Chemical's Tenite butyrate has been introduced by Sloane Mfg. Co. The interior surfaces, being extremely smooth, permit an unimpeded flow through the unit. When closed, a positive plastic-to-plastic seal is formed. All nine parts, with the exception of the brass screw holding the handle to the stem, are of transparent butyrate and, thus, resistant to corrosion.

The valve is rated at 100 psi., for room-temperature applications. It is available in both slip solvent-cement and threaded styles. Since the stem does not rise, it does not grind into the plastic-to-plastic seat. This often happens with the rising-stem type valves, when particles become lodged therein. There are no washers to deteriorate and cause downtime.

Sloane's globe-type butyrate valve

Readers' Service Item P-3

Colorful vaporizer features melamine cover.

Styled Automatic Vaporizer

An automatic vaporizer which represents an abrupt departure from the rigidly functional design of conventional steam units has been introduced by Saxony Electronics, Inc. Designated the Health Glow Vaporizer, it consists of a four-quart ovenware bowl, molded melamine plastic cover, and rubber-covered iron stand.

The bowl is decorated with turquoise antelope silhouettes, and both the melamine cover and control knob are a shade of turquoise. The melamine offers a smooth, hard surface, resistance to heat and solvents, and long service life. Electrical insulating characteristics are excellent.

Safety features include a night light mounted in the knob, and an automatic current shut-off. Another innovation is the dial vapor control which regulates the flow of steam as desired. The vapor spout can be turned in any direction.

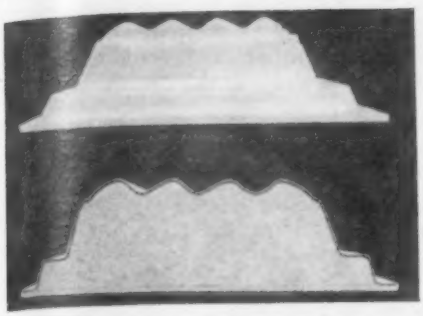
Readers' Service Item P-4

All-Plastic Refrigerator Door

A lightweight, all-plastic refrigerator door has been introduced by Strick Plastics Corp. Called Lami-plast, the door was designed originally for use in refrigerated trailers, trucks, and railway cars. On a custom basis, it is easily adapted to commercial coid-room applications.

The door pan is vacuum-formed on the world's largest vacuum-forming unit to the desired depth and contour. Pans measuring up to 52 by 102 inches can be formed in one piece; larger doors require split sections. Royalite and other copolymers have been used to obtain the desired abrasion resistance and structural strength.

The door face is Strick's Lamicor, a dimensionally-stable, glass fiber-reinforced polyester sheet. Alternate door-facings are aluminum and Lamiclad. The latter material is made by laminating Lamicor to both sides of a hard plywood panel and sealing the edges with epoxy adhesives.



Plastic refrigerator-door pan is insulated with closed-cell plastic foam.

Closed-cell plastic foam, fitted to the contour of the door pan, is used for insulation. This type of insulation furnishes high thermal insulation, and added strength with very little increase in weight. The pan is bonded to the door face with a permanent adhesive, and plastic welding is available if desired. The door can be supplied with hardware to customer specifications.

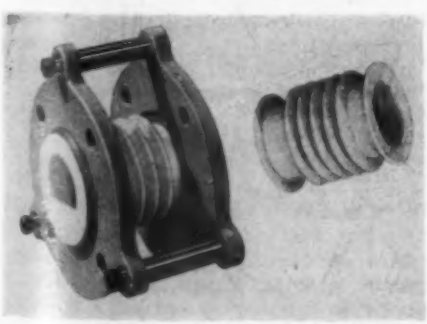
Readers' Service Item P-5

Teflon Joints & Bellows

A complete line of expansion joints and couplings with replaceable Teflon bellows for glass, stainless steel, and glass-lined pipe has been introduced by Chicago Gasket Co. Called Teflex, the bellows can be removed on the job for inspection, cleaning, or replacement.

Designed for use in the food, pharmaceutical, and chemical industries, the bellows are recommended for use where vibration, misalignment, and temperature differentials exist. Heat- and chemically-resistant, the fluorocarbon bellows guard against breakage and contamination.

Teflex bellows are rated at 50 psi. under room-temperature conditions, 34 psi. at 150° F., and 25 psi. at 200° F. Both the bellows and expansion-joint assemblies are available for all sizes of pipe up to six inches in diameter. Special-size bellows can be obtained on a custom bases.



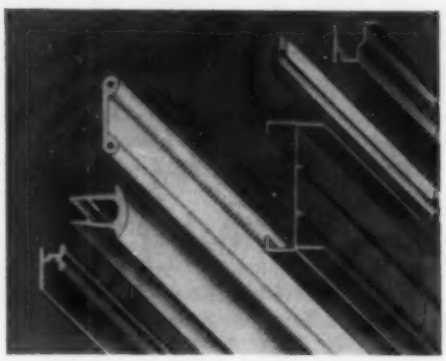
Expansion joint with removable Teflon bellows.

Readers' Service Item P-6

Custom Plastics Extrusions

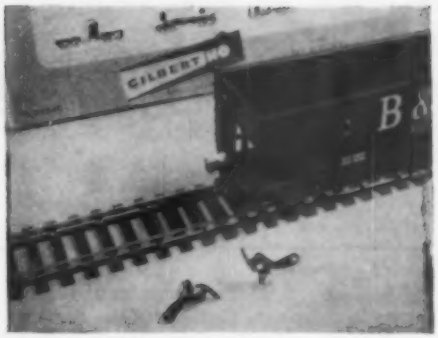
Complex plastic extrusions are now available from Anchor Plastics Co., Inc., Long Island City, N. Y., on a custom basis. Close tolerances are held, and both thin and heavy-wall sections can be obtained in a variety of rigid and flexible shapes.

A complete selection of colors, including crystal, may be specified, as well as surface finish. Extruded plastic shapes can be ordered in random lengths, or precision-cut to exact lengths of ⅛-inch and up.



Complex extrusions available from Anchor Plastics.

Readers' Service Item P-7



Molded nylon precision couplers for toy trains.

Nylon Coupler For Toy Train

Miniature railroad enthusiasts had been plagued with problems of car interchangeability for a long time. The development of the standard coupler for HO trains solved this problem, but created another—production of a highly-complex shape measuring less than 3/4-inch in any direction.

Gries Reproducer Corp., specialists in the molding of tiny parts, has been making the couplers for Gilbert and other toy-train manufacturers. Uses a single-cavity mold to assure dimensional stability.

Readers' Service Item P-8

RC

POLYESTER F-1

A modified glycol-polyadipate specifically designed for reaction with diisocyanates to produce . . .

POLYURETHANE flexible foams & films

SPECIFICATIONS	
Acid Number	1.5 Maximum
Hydroxyl Number	58-62
Viscosity, cps. @ 25°C.	10,000-13,000
Color, Gardner	5 Maximum
Sp. Gr., 20/20°C.	1.195±0.005
Moisture, %	0.0

Evaluate RC POLYESTER F-1 in POLYURETHANE cushioning, coatings, thermal insulation, toys, sponges, jacket-liners, carpet underlays, automotive padding, rubber lacquers, wire insulation, and in hundreds of additional applications!

WRITE TODAY! Ask for our technical data sheet on RC POLYESTER F-1. We'll be glad to send you samples!

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New Literature

Write item numbers on Readers' Service card to obtain copies.

"A List of Dag Dispersions for Industry." Acheson Colloids Co. 4 pages. Forty-four colloidal and semi-colloidal dispersions of graphite, molybdenum, disulfide, mica, vermiculite, zinc oxide, acetylene black, copper, and glass are listed along with their carriers, diluents, properties, and applications.

Readers' Service Item L-1

"Hi-Sil X303." Hi-Sil Bulletin No. 2. Columbia-Southern Chemical Corp. 1 page. Physical and chemical properties are listed for the material, which is used in plastics, varnish, inks, greases, and as a reinforcing filler in silicone rubber stocks.

Readers' Service Item L-2

"Regrinding Rubber Rolls." Report No. 12. Rodney Hunt Machine Co. 2 pages. The report discusses regrinding equipment, listing specifications for several all-purpose grinding wheels. Recommendations are made with respect to diameter, face width, and grain coarseness, plus speeds of rotation. Instructions are given for making cuts without burning the rubber.

Readers' Service Item L-3

"Diethylene Glycol and Triethylene Glycol." F-8085. Carbide & Carbon Chemicals Co. 16 pages. Data on physical and physiological properties, shipping, and constant-boiling mixtures are given for these resin and plasticizer intermediates. The glycols also are used as heat-transfer fluids, solvents, and lubricating agents.

Readers' Service Item L-4

"Low-Cost Production of Polyurethane Plastic Foams." Gabriel Williams Co., Inc. 4 pages. Specifications and dimensions are given for the Klauder Williams Foam Machine, Model 800, which reportedly blends or foams all available formulations by means of a continuous, proportionate metering and mixing system.

Readers' Service Item L-5

"New Formica Cirprint." Formica Corp. 4 pages. Properties and characteristics are given for the material, a copper-clad plastic laminate specifically developed for printed circuits.

Readers' Service Item L-6

"Modulume Modular Lighting System." Lam Workshop, Inc. 8 pages. This illustrated catalog lists dimensions and applications for the firm's modular plastic diffusers and aluminum tracks. Ceiling and cornice end-traps are available for the modules, which are V-shaped in cross section.

Readers' Service Item L-7

"Teflon Spaghetti Tubing." Bulletin BR-4A. Polymer Corp. of America. 2 pages. This bulletin describes the advantages of Teflon sleeving for electric and electronic components. A specification table of 26 different sizes in ten different colors is included.

Readers' Service Item L-8

"Conversion Factors." Precision Equipment Co. 2 pages. This reference table for engineers and technical personnel contains many standard conversions as well as some that are difficult to find in reference manuals. Some of the company's auxiliary shop equipment are described and illustrated on the back of the chart.

Readers' Service Item L-9

"Flammable Liquid Hazards in the Plastics Industry." Society of the Plastics Industry, Inc. 4 pages. Flammable liquids are defined and classified; confinement, ventilation, isolation, ignition sources, and explosion vents are explained; and a program for fire prevention and control is outlined.

Readers' Service Item L-10

"Primary Amyl Alcohol." F-8517C. Carbide & Carbon Chemicals Co. 4 pages. Properties and specifications are given for the material, which is made by the oxonation of refined butylenes. It is used as an intermediate in plasticizer manufacture, and in the production of vinyl stabilizers and resin catalysts.

Readers' Service Item L-11

"Poly-Koolfoam Costimator." Dayton Rubber Co. Nomagraph pad. Intended for users of foamed-in-place urethanes, the pad enables the purchaser to calculate material costs and weights if area, thickness, and density are known.

Readers' Service Item L-12

"Poly-Koolfoam Foamed-In-Place Polymer." Dayton Rubber Co. 13 pages. This combination catalog and file folder contains data sheets on the two-component formulations; lists applications and electrical properties; and describes bonding, adhesion, and thermal conductivity of the foams.

Readers' Service Item L-13

"Heating Cylinder Developments." Injection Molders Supply Co. 12 pages. This booklet is a reprint of a talk given by IMS president A. R. Morse before the Rochester Section, Society of Plastics Engineers, Inc., on February 25, 1957.

Readers' Service Item L-14

"Krene Cast Vinyl Film." Bakelite Co. 20 pages. Physical properties and chemical resistance are given for both plasticized and unplasticized films. Photographs of a number of applications are included.

Readers' Service Item L-15

"Industrial Glass Fabrics." Exeter Mfg. Co. 4 pages. Such data are quoted as thickness, weight per yard, construction ends & picks per inch, break strength, weave, finishes, and available widths.

Readers' Service Item L-16

"A Beautiful Lawn—At a Twist of Your Wrist." Spencer Chemical Co. 12 pages. This illustrated booklet contains a comprehensive description of a polyethylene-pipe sprinkling system, methods of installation for the "do-it-yourselfer," and a list of sprinkler system suppliers.

Readers' Service Item L-17

"Nine Marvinol PVC Resins." Naugatuck Chemical, division of United States Rubber Co. 4 pages. Uses, special features, resin properties, and product properties are quoted.

Readers' Service Item L-18

"How To Use Elmer's Contact Cement." Borden Co. 4 pages. This illustrated folder gives detailed instructions for bonding plastic laminates, installing plywood panels, and adhering many other materials by means of Borden's cements.

Readers' Service Item L-19

"Chem-Weld Drainage Pipe." Southwestern Plastic Pipe Co. 4 pages. This illustrated brochure describes the firm's plastic pipe and fittings, and gives instructions for installation and handling.

Readers' Service Item L-20

"IMS 1957 Nozzle Catalog." Injection Molders Supply Co. 52 pages. Complete

New Literature (Cont'd.)

data and prices are given for approximately 2,000 stock-model nozzles and nozzle taps. New mixing nozzles are included, together with technical notes on nylon molding and nozzle design. Order blanks are included.

Readers' Service Item L-21

"Small Parts for Industry." Gries Reproducer Corp. 9 pages. A complete, classified listing of the firm's 67 different zinc alloy die-cast and thermoplastic molded products is contained in this bulletin. Gries carries many of the items in stock; others are molded or die-cast to customer specifications.

Readers' Service Item L-22

"Durez 16274 Natural." Durez Plastics division, Hooker Electrochemical Co. 4 pages. This brochure lists physical and electrical properties, discusses molding techniques and equipment, and describes finishing operations for the material, a mineral-filled phenolic.

Readers' Service Item L-23

"Ethylene Oxide." Technical Bulletin 1956. Jefferson Chemical Co., Inc. 42 pages. Analytical procedures, physical and chemical properties, and industrial uses of ethylene oxide are given in this bulletin. Also included are data on handling techniques, toxicity, and specifications of commercial grades.

Readers' Service Item L-24

"Harshaw Industrial Chemicals." Harshaw Chemical Co. 22 pages. The company's products, plants, and services are described and listed in this illustrated bulletin.

Readers' Service Item L-25

"Polyethylene Fittings & Pipe for Lanco Polyethylene Sink Traps." Arthur S. LaPine & Co. 1 page. This illustrated data sheet describes and prices the firm's new line of insert-type polyethylene fittings and pipe for use with polyethylene sink traps.

Readers' Service Item L-26

"Rotary-Vac Three-Stage Vacuum Forming Machine." Comet Industries. 2 pages. Specifications and a photograph of the unit are included in this bulletin.

Readers' Service Item L-27

"Silicones." CDS-97. General Electric Co., Silicone Products department 8 pages. Over 115 different applications for silicones are described and illustrated in this catalog.

Readers' Service Item L-28

"Ray-Bond Adhesives, Protective Contings, and Sealers." Bulletin No. 650A. Raybestos-Manhattan, Inc. 4 pages. In tabular form, the recommended use, method of application, and properties of eight typical Ray-bond adhesives are presented. A graph shows the shear strength of five thermosetting adhesives in the temperature range from 100-650° F.

Readers' Service Item L-29

"This is Emery." Emery Industries, Inc. 16 pages. The illustrated brochure summarizes the company's history since 1840. It contains a popular description of their processes, facilities, and scope of operations.

Readers' Service Item L-30

"Baker Self-Contained Automatic Molding Presses." Baker Brothers, Inc. 6 pages. The pamphlet describes the operating features of the firm's automatic molding presses and gives general specifications for eight models ranging in size from 60-450 tons.

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Book Reviews

"Quality Control for Plastics Engineers," Edited by Lawrence M. Debing. Reinhold Publishing Corp., 430 Park Ave., New York 22, N. Y. Cloth 6¼ by 9¼ inches, 166 pages. Price, $4.95.

First in a series of technical volumes sponsored by the Society of Plastics Engineers, Inc., this work introduces the subject of statistical quality control with particular reference to the plastics industry. The treatment assumes that the reader has no previous knowledge of the subject. Its stated purpose is to enable engineers, molders, fabricators, and manufacturers of plastics to use basic statistical procedures in order to achieve the highest possible standards of performance.

The use of frequency distributions in plastics molding is discussed, along with normal frequency distribution and its tie-in with industrial processes. Control charts for variables and attributes are described in detail, and many charts and formulas are included. Specifications and sampling inspection are covered, and the latter's statistical correlation. The book closes with a chapter on statistical experiments in plastics fabrication.

"Automation: Its Purpose & Future." Magnus Pyke. Philosophical Library, Inc., 15 East 40th St., New York 16, N. Y. Cloth, 5½ by 8½ inches, 191 pages. Price, $10.00.

The author reviews the past history of automation, including the digital computer and its development. Automation in the mass-production industries is described, as are the uses of computors in the manufacture of special machine tools and precisely-constructed parts.

Chapters are devoted to the use of automation in engineering, chemistry, petroleum industry, accounting, transportation, food and catering, guided missiles, and translation. Factors affecting the speed with which automation is likely to spread also are covered.

"Textbook of Polymer Chemistry." F. W. Billmeyer, Jr. Interscience Publishers, Inc., 250 Fifth Ave., New York 1, N. Y. Cloth, 6¼ by 9¼ inches, 520 pages. Price, $10.50.

Based entirely on previously published information, this textbook on the organic and physical chemistry of high polymers contains general and specific references at the end of each chapter. No prior knowledge of high polymers is assumed; however, the book is written on the graduate level.

Following an introduction to the structure and properties of polymers, the book is divided into five parts covering the following general headings: Physical Chemistry of Polymers, Kinetics of Polymerization, Properties of Plastics, Properties of Fibers, and Properties of Elastomers. Numerous formulas, graphs, schematic diagrams, and photos are included. A three-part appendix contains a listing of symbols, a table of physical constants, and a list of trade names.

"The Mechanical Properties of Polyester Laminates Reinforced with High-Modulus Glass Fabric." F. Werren, Forest Products Laboratory, U. S. Department of Agriculture for Wright Air Development Center. Order PB 121683 from OTS, U. S. Department of Commerce, Washington 25, D. C. Paper, 22 pages. Price, 75¢.

Elastic properties and strength of a polyester laminate reinforced with 181 glass fabric were shown to be equal or higher than those reinforced with H.M. 18 glass fabric, a high-modulus material. Resin contents were 41.9 and 34.18% for the H.M. laminates; 37.6% for the 181 specimen.

Results of tension, compression, and flexure tests showed the mechanical properties of a 181 laminate to be equal or greater than those of a H.M. laminate with the same resin content. Reduction of resin content raises the strength and elastic properties of both types.

"Development of Heat-Resistant Interlayer Materials for Laminated Plastic and Laminated Glass." R. P. Cox and others, Bjorksten Research Laboratories, Inc., for Wright Air Development Center. Order PB 121665 from OTS, U. S. Department of Commerce, Washington 25, D. C.

Silicone-acrylate copolymers were shown to withstand temperatures of 400° F., better than a number of transparent interlayer materials for laminated glass and plastic. These copolymers were prepared by the addition of vinyl polysiloxane to low molecular weight polyethyl acrylate in the ratio of 1:99.

The above-mentioned interlayer was resistant to high humidity, and its optical properties were unimpaired at high temperatures. Discoloration was slight after six hours at 350° F. Mylar interlayers showed promise, with a tensile strength of 25,000 psi., high-temperature stability, and low-temperature flexibility; however, its lack of formability restricted its use to glass laminates. Other materials tested were nylon, polyester, cellulose esters, fluorinated resins, and epoxies.

Abstracts of Important Articles

Materials

"Poly (vinyl Alcohol) as an Emulsifying Agent in Vinyl Polymerizations," J. N. Coker, *Ind. Eng. Chem.*, 49, 3, 383 (March 1957).

Low-viscosity, partially-hydrolyzed polyvinyl alcohol can be used with various anionic surface-active agents to prepare fluid polystyrene latices containing from 30-40% solids.

"Permeation, Diffusion, and Solubility of Methyl Brome and Isobutene in Polyethylene," Igor Sobolev, J. A. Meyer, Vivian Stannett, and Michael Szwarc, *Ind. Eng. Chem.*, 49, 3, 441 (March 1957).

A description of tests and the results obtained, covering the subjects of permeability isobars and isotherms, and the pressure and temperature dependence of permeability.

"Glass-Flake Laminates," George Rugger, *SPE J.*, 13, 4, 35 (April 1957).

The method of preparing glass-flake laminates is described, and the laminates themselves are shown to be acceptable for some applications in their present stage of development, although not superior in all properties. The most striking of their characteristics are extreme stiffness, energy absorption ability, and lower cost.

"Shrinkage of Thermosets," A. J. Guzzetti, *Modern Plastics*, 34, 6, 111 (Feb. 1957).

An investigation of the mechanisms involved during shrinkage, and the effects of molding factors such as mold temperature, preform temperature, applied pressure, and piece cooling rate, and various molding and piece design variables.

"High-Shear-Rate Rheological Properties of Plastics," A. C. Werner, *Modern Plastics*, 34, 6, 137 (Feb. 1957).

Previously-reported work is reviewed and expanded upon, and recent work on the measurement of rheological properties of plastisols is discussed. Data are included on the use of the Severs rheometer to measure low shear rate viscosity properties.

"Environmental Stress Cracking of Ethylene Plastics," K. A. Kaufmann, *Modern Plastics*, 34, 6, 147 (Feb. 1957).

This article consists essentially of a description and discussion of a proposed method of test for environmental stress cracking set up by Subcommittee XV on Thermoplastic Materials of A.S.T.M. Committee D-20 on Plastics.

"Penton—A New Chlorine-Containing Polymer," E. W. Cronin, *Modern Plastics*, 34, 2, 150 (Feb. 1957).

An A.S.T.M. paper, this article gives the structure and comparative properties of Penton.

"Temperature - Property Relations in Melamine- and Silicone-Glass Fabric Laminates," W. N. Findley, H. W. Peithman, and W. J. Worley, *Modern Plastics*, 34, 7, 185 (March 1957).

Results are reported of tests on static tension, static compression, tension creep, and time-to-fracture of both types of laminates at high temperatures.

"Adhesives for Vinyl Film Laminations," Sam Gold, *Modern Plastics*, 34, 7, 208 (March 1957).

The discussion of adhesives includes mention of laminating methods and adhesive evaluation techniques.

"High-Loading-Rate Tensile Properties of Thermoplastics," Stephen Strella and Lucius Gilman, *Modern Plastics*, 34, 9, 128 (April 1957).

A high-rate tensile tester is described, and preliminary data given on 20 thermoplastics tested with this device.

"The Effect of Carbon Black on the Stability of Polyethylene," J. T. Moynihan, *SPE J.*, 13, 2, 23 (Feb. 1957).

The mechanisms of preservation of polyethylene exposed to light and weathering degradation are described, with mention of the effects of oxygen content, and other variables.

"High Speed Injection Studies on Polystyrene," L. E. Tallman and O. G. Maxson, *Western Plastics*, 4, 3, 43 (March 1957).

An SPE Conference paper describing studies being carried on by Dow Chemical Co. Results to date show that higher pressure, measured-starved feed, and fast injection speed are instrumental in upgrading the quality of molded items, particularly thin-wall items.

"Measurement of Cure Rate of Thermosetting Molding Materials," A. J. Guzzetti, *A.S.T.M. Bull.*, 220, 57 (Feb. 1957).

Results are given to show that cure speeds of thermosets may be estimated from the rigidity of hot molded pieces immediately upon discharge from the mold, with results expressed as an apparent modulus of elasticity.

"Influence of Process Variables on Shrinkage of Moldings of 'Teflon' Polytetrafluoroethylene Resins," F. M. Chapman and L. T. Bunn, *SPE J.*, 13, 2, 37 (Feb. 1957).

An SPE Conference paper, this article describes an investigation of such variables as preform pressure, cooling rate, sintering time, dwell time, ram speed, and heating rate.

"Accelerated Fatigue of Plastics," L. S. Lazar, *A.S.T.M. Bull.*, 220, 67 (Feb. 1957).

A preliminary investigation of relatively-simple polymer systems under various fatigue conditions shows the Prot method to yield a good approximation of the endurance limit, as obtained from conventional fatigue tests.

"Bulk Compressibility of Polymers at Fabricating Temperatures," Bryce Maxwell and S. Matsuoka, *SPE J.*, 13, 2, 27 (Feb. 1957).

A study of the effect of compression of the melted plastic due to hydraulic pressure during injection. This effect is shown to vary with the type of plastic being molded.

"Persistent Problems in the Field of Reinforced Plastics," B. Parkyn, *Brit. Plastics*, 29, 12, 452 (Dec. 1956).

The problems considered are the high degree of scatter of physical test data on glass-polyester laminates; painting and finishing wet lay-up moldings; degree of cure; mass production of glass-polyester moldings; and yellowing of corrugated roof sheeting. Some of the more important facts known about each problem are discussed.

"Pyromellitic Dianhydride in Curing of Epoxy Resins," R. B. Feild and C. F. Robinson, *Ind. Eng. Chem.*, 49, 3, 369 (March 1957).

Data are presented to show that epoxy resins cured by pyromellitic dianhydride mixtures at or above heat-distortion temperatures have significant retention of physical strength.

"PVC Pastes—Theory and Practice," M. S. Welling, *Plastics*, 21, 225, 121; 21, 226, 161; and 21, 227, 194 (June, July, August 1956).

In the three parts of this article, the author deals successively with the factors to be considered in PVC paste formulation and the various processes in which these formulations are used, aiming at presenting a complete picture of the constituent ma-

terials of the pastes and the technology of application. He considers spread-coating of fabrics and finishing methods; the elastomer process and blowing methods for producing open and closed cell types of cellular PVC; hot and cold dipping techniques; and slush molding.

"Critical Temperatures of a Series of Peroxides in Polyester Resins," J. W. Cywinski, *Brit. Plastics*, 29, 10, 377 (Oct. 1956).

Investigations of critical temperatures were carried out by determining polymerization curves showing the temperature rise in polyester resins under the influence of the exothermic reaction in the presence of various peroxides. The process is similar to the proposed method for determining gelling time, except that instead of one bath, use is made of a series of glycerine baths of temperature ranging from 50-120° C. From the polymerization curves, gelling times and minimum cure times can be calculated for each peroxide at different temperatures.

"Quick Method of Conditioning Plastics for Humidity Control," F. Ecochard and G. Berchet, *Ind. Plastiques Mod.*, 8, 8, 33 (Sept.-Oct., 1956).

The method is based on the diffusion equilibrium between a polymer and an aqueous solution of a salt, the chief advantage being that a state of equilibrium can be obtained in a much shorter time than by the usual methods. Samples of polyamide immersed in a suitable aqueous solution of potassium acetate at 100° C. developed a uniform humidity of 3.5% in five hours, instead of in 30 hours by the usual method. Tests were carried out only on polyamides, but the method may have possibilities for other plastics. (In French).

"Practical Experience with Styropor," F. Stastny, *Plastverarbeiter*, 7, 8, 286 (Aug. 1956).

The method of producing foamed Styropor and Styropor blocks and plates, and their mechanical properties and applications are considered. Results are given of tests on thermal, insulation, acoustic, hygroscopic, and heat-conductivity properties. Tests on mold resistance, effect of moisture on heat conductivity, and dimensional stability of Styropor-wood veneer sandwiches also are briefly described. Mention is made of a special Styropor P grade that is resistant to mineral oil and gasoline. (In German).

"Polymerization of Vinyl Chloride and Structure of Polyvinyl Chloride," G. Bier and H. Kramer, *Kunststoffe*, 46, 11, 498 (Nov. 1956).

The authors describe the present state of our knowledge on the mechanism of vinyl chloride polymerization and the structure of PVC, drawing on the literature as well as on results of their own recent experiments. The reactions of chain transference and rupture are discussed thoroughly, and the presence of double bonds in the polymer is made probable. Other groups (residues of emulsifiers and catalysts) also could be identified in the polymer. The presence of traces of emulsifier was found to affect slightly the molecular weight. The degree of branching depends on the method of polymerization; products prepared by different methods showed differences in the Zn/M relationship. After reduction with lithium aluminum anhydride and infra-red analysis of the resulting polyethylenes, little or no branching was found in these products. The effect of a second vinyl compound on the composition of a vinyl chloride copolymer is illustrated by the example of vinyl chloride/vinyl acetate. (In German).

"Heat Distortion Temperature of Polyester-Styrene Copolymers," E. J. Mouton, *Plastica*, 9, 9, 530 (Sept. 1956).

At the Plastics Research Institute TNO, Delft, Holland, the effect of various factors on the heat distortion temperature (HDT) of polyester-styrene copolymers was studied. Within certain limits, the type and quantity of the peroxide used as catalyst in the preparation of the copolymers had no effect on HDT. The use of an accelerator in addition to the peroxide to achieve hardening at room temperature lowers HDT considerably. By hardening at higher temperatures, higher HDT results. 1,2-Propylene glycol-maleic acid polyesters of the same molecular weight, HDT at most is 160° C. Partial substitution of propylene by ethylene glycol does not raise the HDT. (In Dutch).

"Permeability of Polyethylene to Gases and Vapors," A. W. Myers, C. E. Rogers, V. Stannett, and M. Szwarc, *Modern Plastics*, 34, 9, 157 (May 1957).

Permeability data are given for such polyethylene modifications as crystallinity, irradiation, paper substrate, and grafting of monomers to polyethylene by irradiation.

Equipment

"Maintenance of Frequency and Suppression of Harmonic Vibrations in High Frequency Generators," W. Burkhardtsmaier, *Plastverarbeiter*, 7, 10, 389 (Oct. 1956).

The measures to be taken to maintain frequency and avoid harmonic vibrations in the high-frequency welding of plastics, and problems involved, are discussed. (In German).

"Efficient Production of Molding Tools for the Plastics Industry," R. Kettenbaum, *Plastverarbeiter*, 7, 11, 411 (Nov. 1956).

The Diprofil method for finishing molds and the equipment required are described. (In German).

"Extrusion Equipment," H. M. Whitcut, *Rubber & Plastics Age*, 38, 1, 56 (Jan. 1957).

The general construction of screw extruders and the requirements they should meet are outlined. Then, the important features of a single-screw thermoplastics extruders are considered, as well as accessory equipment such as sizing dies, coilers, conveyors, and others.

Processing

"High-Frequency Preheating of Ureas," H. E. Murray, *Modern Plastics*, 34, 10, 137 (June 1957).

Description of a process whereby large moldings can be made with the fast-curing resins, using carefully controlled high-frequency preheating.

"Pre-Impregnated Reinforcements for Epoxy Laminates," B. F. Godard, P. A. Thomas, and J. L. Welch, *SPE J.*, 13, 5, 26 (May 1957).

The handling and curing techniques for a dry lay-up method using preimpregnated epoxy reinforcement are described, together with the properties of finished products.

"A New Concept for Molding Small Parts," J. H. Hull, *SPE J.*, 13, 5, 21 (May 1957).

Description of a production short-cut for transfer molding of miniature parts using phenolic or alkyd material.

"Shaping Rigid PVC Sheet," H. Oelze, *Kunststoffe*, 47, 2, 93 (Feb. 1957).

Rigid PVC sheet has great possibilities for packaging foodstuffs. The forming methods and equipment for the purposes, and their dependence on the object to be produced, are considered. The processes covered include vacuum and drape forming (combined with pneumatic and mechanical pre-stretching), and die drawing. Molds and some of the equipment needed are described. (In German).

"New Method of Welding Thermoplastics," H. Schulz, *Plastverarbeiter*, 7, 9, 337 (Sept. 1956).

The process and equipment used in a new method of welding rigid PVC in the construction of chemical apparatus are described, using the example of butt-welding. Semi- or fully automatic welding is possible, and the welding rod can be of circular or triangular cross-section. Economical and technological advantages of the process are mentioned. (In German).

"The Whirl-Sinter Process," E. Gemmer, *Plastverarbeiter*, 7, 9, 342 (Sept. 1956).

In the past three years, the whirl-sinter process (German patent No. 933,019) for protecting metal surfaces has been finding increasing application. The part to be treated is placed in a vessel containing a plastic powder. The vessel has a porous ceramic or metal floor to permit com-

pressed air or other gas to be blown through the powder so that it acquires characteristics of a liquid and completely coats the part, whatever its shape or size. However, only the outside of the article is coated. Polyethylene powder, either alone or in combination with polyisobutylene, is used, but good results have also been obtained recently with Plexigum, Perlon, and Rilsan-type polyamides. The process, its applications and apparatus are described. (In German).

"Injection Molding," B. E. Terry, *Trans. Plastics Inst.*, 25, 59, 45 (Jan. 1957).

Production methods employed in injection molding are reviewed, and future possibilities in machine size and automation are mentioned.

"Some Recent Developments in Radio-Frequency Bonding of Plastics Materials," E. C. Stanley, *Trans. Plastics Inst.*, 25, 59, 15 (Jan. 1957).

Recent developments in plastic sheet materials, and the use of comparatively large welding machines and new tooling methods, have made it possible to expand the field of application of welding in inflatables, raincoats, fancy goods, padded upholstery, and panels for handbags. Methods and equipment are considered, with occasional reference to American and European practice.

Applications

"Plastics Products for Improving Paper and Paste-Board," H. Hook, *Plastverarbeiter*, 7, 10, 365 (Oct. 1956).

A number of plastics are currently used to improve the quality and appearance of paper and pasteboard. The specific properties which make four thermosetting products and 10 thermoplastics useful for this purpose are described briefly. (In German).

"Bonding Light Metals with Synthetic Resin Adhesives," H. Peukert, *Plastverarbeiter*, 7, 11, 405 (Nov. 1956).

After explaining the advantages of adhesive bonding over welding and riveting, the author discusses types of cold and hot setting synthetic resins, the principles of adhesive bonding, and factors influencing the bond (including heating temperature and time, pressure, adhesive layer, pretreatment and properties of material to be bonded, and thickness and length of lap joint). (In German).

"The Possibilities of Plastics in Coal Mining," G. R. Rowell, *Trans. Plastics Inst.*, 25, 59, 39 (Jan. 1957).

To interest the plastics industry in underground problems which might be solved with the aid of plastics, the author discusses some recent trends in coal mining. Among newer developments, he mentioned the use of PVA in a spraying operation for streamlining underground roadways; plastic laminates for certain supports in the coal face; the experimental development of phenolic laminates for the roof bar and a mine car with glass fiber walls; and the application of plastics in communications and personnel safety.

"Plastics in the Graphic Industries," F. Pallazzolo, *Mat. Plastiche*, 22, 11, 898 (Nov. 1956).

Vinyl copolymers and cellulose acetate are used in the reproduction of maps, charts, drawings, illustrations, photographs, etc. Methods employed in map-making, including relief maps, and in producing cuts are described. (In Italian).

"Plastics in the Construction of Chemical Apparatus and for Surface Protection," L. Benker, *Plastverarbeiter*, 7, 9, 325 (Sept. 1956).

The use of thermoplastic and thermosetting materials to make unsupported plastic parts for chemical apparatus, as well as to line and coat parts of metal or of other plastics, are reviewed. Among methods of application referred to are the

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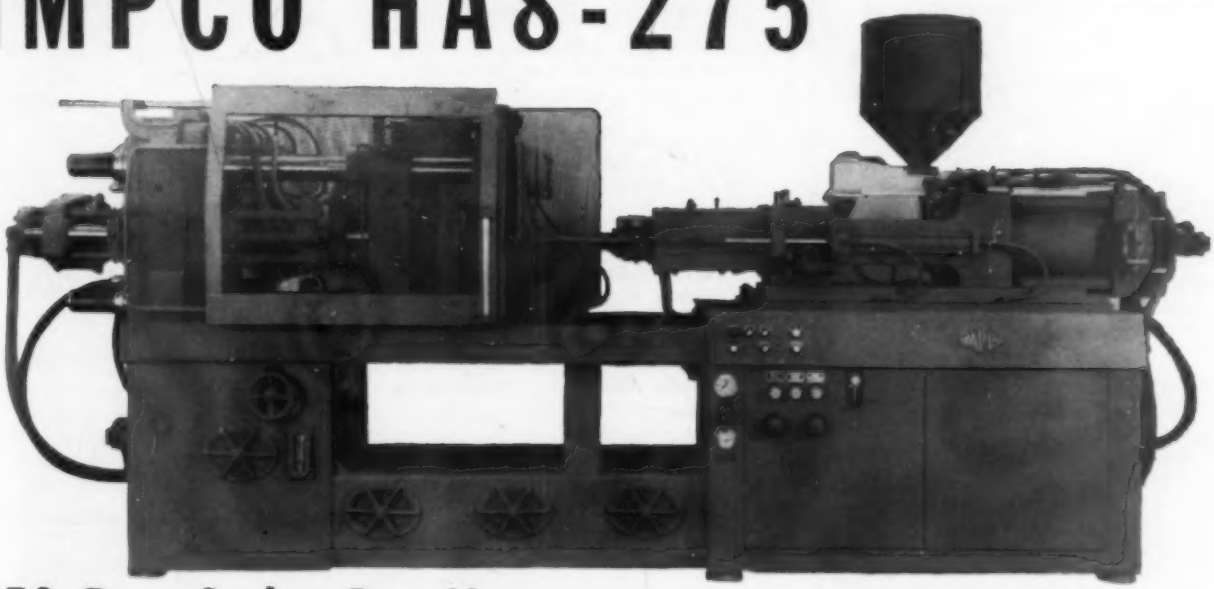

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processes for lining steel containers with polyethylene; whirl-sintering; spraying on polytrifluorochloromethylene; and the use of casting resins to reinforce PVC linings for metal containers or, in combination with fiber-glass, to reinforce pipe of PVC or other plastics. A bibliography is included with 31 references. (In German).

"Rigid Vipla (PVC) Piping in an Irrigation Installation in the Northern Apennines," G. Fuscagni, *Mat. Plastiche*, 22, 11, 913 (Nov. 1956).

The problems involved in transporting and laying rigid PVC pipe for an irrigation project in a mountainous district having large outcroppings of rock and steep slopes, and how they were solved, are described. (In Italian).

"High Tension Laminates," L. Blumental, *Ind. Plastiques Mod.*, 9, 1, 14 (Jan. 1957).

Requirements for solid, high-tension insulators are made best by laminates of paper-supported phenolics. The materials employed and the production and properties of such products are discussed. Tables present the characteristics of suitable papers, and the electrical, mechanical, and thermal properties of laminates in the form of sheets and cylinders. The significance of dielectric loss and thermal breakdown, and the effects of humidity are considered. Other laminates are referred to briefly, including phenolics and cotton, phenolics and glass-fiber cloth, and epoxy/glass fiber products. (In French).

"The Use of PVC Pastes in Offset Lithography," A. E. Jackson and A. Blake, *Plastics (London)*, 21, 231, 358 (Dec. 1956).

In a new method of producing offset plates, a specially-compounded PVC paste is applied to the surface of a paper plate by way of a photographic stencil. A typical formulation for a paste is given, and the process used is described.

"Selecting Plastics Laminates for Industrial Use," M. W. Riley, *Materials & Methods*, 45, 2, 121 (Feb. 1957).

A simplified guide to the proper use of vulcanized fiber and thermoset reinforced laminates.

"Pressure-Resisting Cable Entry Glands," H. H. Greenwald, *Brit. Plastics*, 30, 1, 20 (Jan. 1957).

The operation of telecommunication cables requires the use of "repeaters" to amplify the electrical signals. With submarine cables, these repeaters are placed at regular intervals along the length of the cable resting at the bottom of the sea, hence must be housed in casings capable of withstanding considerable hydrostatic pressure. A problem is to pass the cable through the casings so that its insulation properties are not impaired, the structure of the seal can resist the hydrostatic pressure, and water does not enter along the cable. This problem was solved by an injection-molded polyethylene gland. The special production technique employed and the experimental work carried out are described.

"The Use of Plastics in High-Energy Nuclear Research," J. O. Turner, *SPE J.*, 13, 3, 26 (March 1957).

Work on plastics for nuclear research at the University of California's Radiation Laboratory is described. Applications are cited for cast epoxy, glass-epoxy, polyethylene, and acrylics.

"Vinyl Coatings for Metal Products," R. A. Calsibet, *Materials & Methods*, 45, 3, 130 (March 1957).

The fourth of a series, this article discusses the applications of vinyl dispersion and solution coatings and wash primers.

Request for copies, reprints, or further information on any article abstracted in this department should be addressed to the publisher of the magazine where the article appeared. The publishers and their addresses are given below:

"ASTM Bulletin"
American Society for Testing Materials
1916 Race St., Philadelphia 3, Pa.

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341 Church St., Toronto, Ont., Canada

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1155 Sixteenth St. N.W.
Washington 6, D. C.

"Hule Mexicano y Plasticos"
Filomeno Mata 13-11, Mexico, D.F.

"Industrial and Engineering Chemistry"
1155 Sixteenth St. N.W.
Washington 6, D. C.

"Industries des Plastiques Modernes"
Les Publications Techniques Associees
40 Rue du Colisee, Paris 8e, France

"Kunststoffe"
Carl Hanser Verlag
Leonard Eck Str. 7, Munich 27,
Germany

"Kunststoff-Rundschau"
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Germany

"Materials and Methods"
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430 Park Ave., New York 22, N. Y.

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"Plastics"
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Bowling Green Lane, London E.C.1,
England

"Plastics World"
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22 W. Putnam Ave., Greenwich, Conn.

"Plastiques Informations"
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Paris 9e, France

"Plastverarbeiter"
Verlagsgec. m.b.H.
Herxheim b. Landau/Pfalz, Germany

"Poliplasti"
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Milan, Italy

"Revista de Plasticos"
Inst. "Alonso Barba"
Serrano 119, Madrid, Spain

"Revue Générale des Matiéres Plastiques"
196 Ave. Jean-Jaures, Paris 19e, France

"Rubber and Plastics Age"
Rubber and Technical Press, Ltd.
Tenterden, Kent, England

"SPE Journal"
Security Bank Bldg., Athens, Ohio

"Transactions of the Plastics Institute"
9 Mandeville Place, London W. 1,
England

Patent Digest

Materials

Process For Improving Characteristics of Plasticizers and Products Therefrom. No. 2,776,984. Maurice Mention and Pierre Bourguignon, Melle, France (to Les Usines de Melle [Societe Anonyme], Saint-Leger-les Melle, France).

Alumina, in a proportion of at least 10% by weight, is brought into contact with an ester plasticizer at a temperature from 20-200° C. for about 15 minutes. The plasticizer is formed from an acid selected from the group consisting of monocarboxylic aliphatic acids, dicarboxylic aliphatic acids, and dicarboxylic aromatic acids; and an alcohol selected from the group consisting of mono- and di-hydric aliphatic alcohols. Each of the acids and alcohols must contain 6-10 carbon atoms in their respective chains and rings. The alumina and plasticizer are separated, and the recovered plasticizer has improved characteristics, including increased electrical resistivity.

Modified Amide-Aldehyde Resins From Amides of Oxidized Paraffin Acids. No. 2,776,949. John P. Buckman, Yorba Linda, Calif. (to Union Oil Co. of California, Los Angeles, Calif.).

A resin composition is prepared by reacting a fluid amide, an aldehyde substance, and an alcohol at a temperature between about 50-150° C. The alcohol is an acyclic monohydroxy alcohol having 2-8 carbon atoms per molecule. The fluid amide is prepared by amidating a fraction separated from an oxidized wax. The fraction is insoluble in water and in petroleum naphtha, and has a saponification number: acid number ratio between 1.4-2.2:1, and a total oxygen-carboxyl ratio between 1.2-1.8:1. The wax from which it is separated is prepared by oxidizing paraffin wax with a gas containing free oxygen at a temperature between 100-140° C., the resultant oxidized product having an acid number between about 200-350 mg. KOH/g.

Polyethylene Refining. No. 2,776,274. Robert E. Cairns, Springfield, Mass. (to Monsanto Chemical Co., St. Louis, Mo.).

Polyethylene is refined by subjecting it to intensive mixing in an enclosed chamber under positive pressure. The mixing action is applied by a number of spirally shaped rotating members which turn at different peripheral speeds. The process is restricted to the following cycle: the polyethylene is mixed at 20-30 psi. for no more than two minutes with the faster rotating member moving at a peripheral speed of 200-285 feet per minute; then, the mixing is continued at the same speed with the pressure reduced to five psi. The rotating members and the walls of the chamber are cooled by the circulation of water at 35-80° F. The entire cycle must have a duration of at least five minutes, and results in the substantial removal of fisheyes.

Synthetic Polyamide Resins from 5-t-Butyl-m-Xylylene Diamine. No. 2,776,-950. Funston G. Lum and Earl F. Carlston, Richmond, Calif. (to California Research Corp., San Francisco, Calif.).

A polyamide resin of 5-t-butyl-m-xylylene diamine, and an aliphatic dicarboxylic acid of 6-10 carbon atoms.

Ethyl Cellulose Emulsions. No. 2,776,-904. Werner C. Brown, Deerhurst, Del. (to Hercules Powder Co., Wilmington, Del.).

Ethyl cellulose is dissolved in a water-immiscible liquid by being agitated with water in the presence of a nonionic surface-active agent which is an addition product of an alkylene oxide. The nonionic substance acts as an emulsifier to produce a lacquer emulsion containing the ethyl cellulose in the dispersed phase.

Compositions Comprising Plasticized Acrylonitrile Polymers and Molded and Extruded Articles Made Therefrom. No. 2,776,946. Marion R. Lytton, West Chester, Edward A. Wielicki, Philadelphia, and Ellis Lewis, Jenkintown, Pa. (to American Viscose Corp., Philadelphia, Pa.).

The composition is a moldable mixture comprising finely-divided particles of polyacrylonitrile and bis (beta-cyanoethyl) nitrosamine in an amount of about 10% of the combined weight of the polyacrylonitrile and nitrosamine.

Polymer Dispersions. No. 2,776,947. Calvin E. Schildknecht, Montclair, N. J. (to Celanese Corp. of America, New York, N. Y.).

A process for the production of a stable dispersion of a copolymer of acrylonitrile and N-vinyl lactam containing at least 70 mole per cent of acrylonitrile. A non-solvent for the copolymer, miscible with the solution, is added to precipitate at least a portion of the copolymer as a non-settling dispersed phase capable of scattering light.

Synthetic Resins Derived From Hydroxymethylfurfural and Phenols. No. 2,776,948. Francis H. Snyder, Newtown, Conn. (to Dendrol, Inc., Memphis, Tenn.).

A process of preparing a synthetic resin which comprises reacting hydroxymethylfurfural with a phenol of the class consisting of hydroxybenzene, resorcinol, and the cresols, xylenols, and crude mixtures thereof, under alkaline-condensing conditions.

Furfural-ketone Compositions of Matter and Methods of Making Same. No. 2,776,-272. Mortimer T. Harvey, South Orange, N. J. (to Harvel Research Corp.).

A composition consisting of styrene intimately combined with an organic reaction product being liquid at 100° C. The organic reaction product is selected from the group consisting of monofurfurylidene ketone; difurfurylidene ketone; organic reaction masses produced by an alkaline reaction of furfuraldehyde and a ketone having two hydrogen atoms on an alpha-carbon, the resultant mass having a viscosity of at least 50 cps. at 25° C.; residual fractions of the organic reaction masses produced by their heat distillation and measuring about 60%, by weight; and polymerized products produced by polymerizing the above components under acidic conditions.

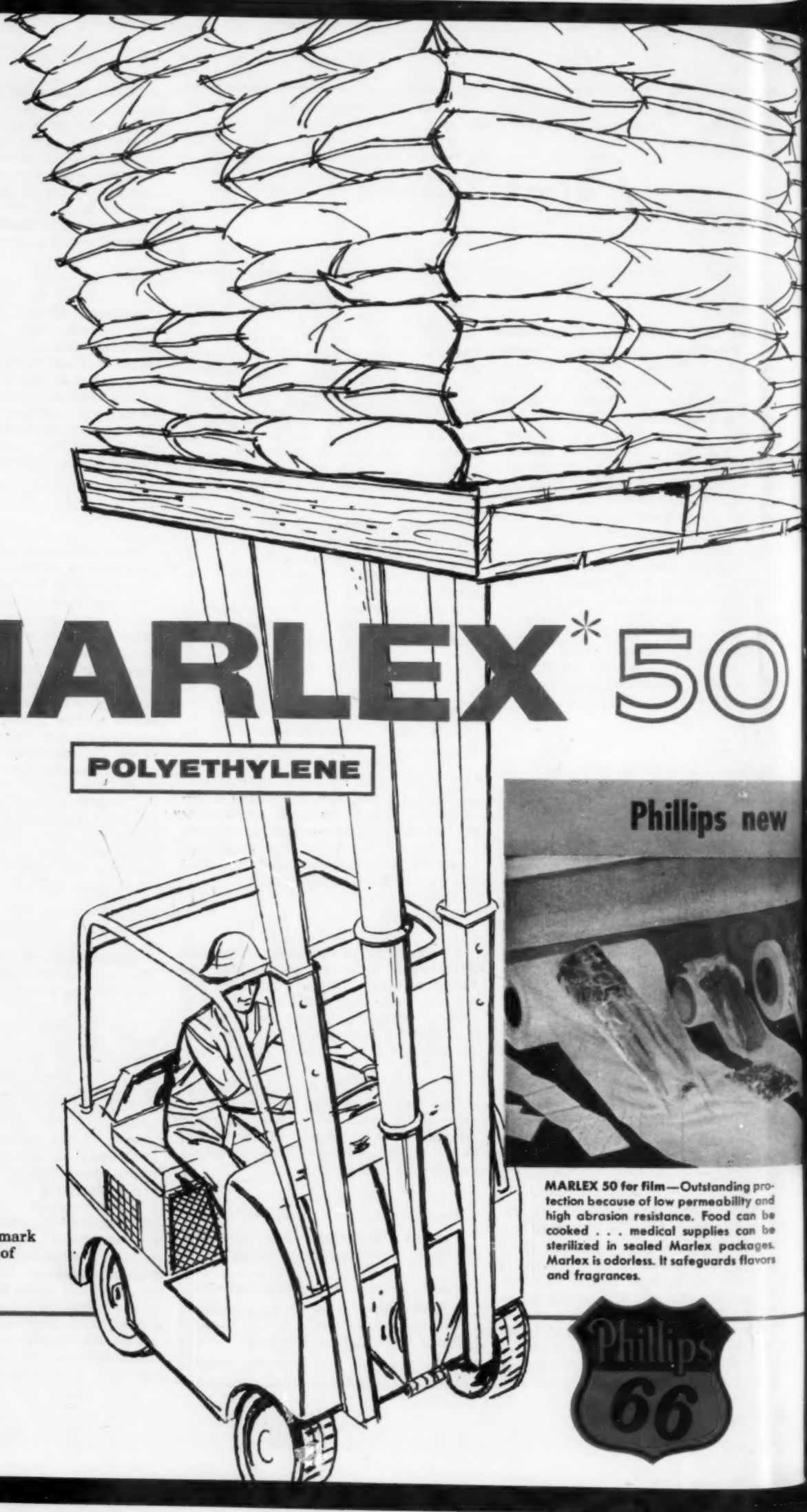
Composite Sheet Material. No. 2,777,-788. Lawrence D. Bragg, Jr., Andover, Mass. (to The General Tire & Rubber Co., Akron, Ohio.)

A flexible sheet material consisting of a lamina of polyvinyl plastic and a coextensive multilayer lamina of felt sheeting having a dry weight from 3-6 ounces per square yard. The felt material is composed of nylon and wool fibers; the nylon constituting 30-35%, by weight, of the total volume of the sheeting. The nylon and wool fibers are arranged in at least eight layers, with the fibers oriented in one direction in the plane of the layer. The layers are super-imposed, one upon the other, with the fiber orientations of adjacent layers having an angular relationship not greater than 60°. The fibers of the top and bottom layers are oriented in the same direction. The nylon fibers are bonded together at their intersections by a butadiene-acrylonitrile copolymer and the layers are compacted to form a web with substantially uniform stress and strength in all direc-

(*Continued on page 516*)

Printed copies of patents are available from the Commissioner of Patents, Washington 25, D. C. Price, 25c each.

—The Editor



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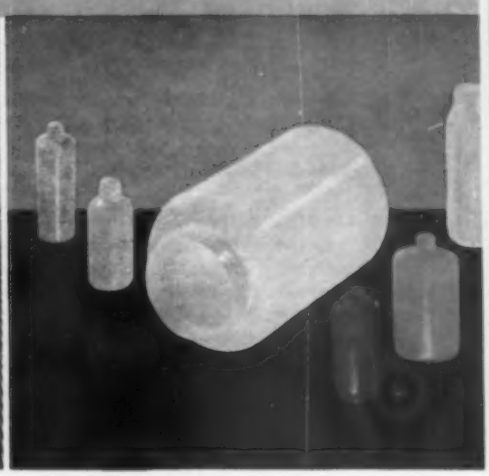

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Patent Digest (Cont'd. from page 513)

tions. The laminae are secured together by a vinyl adhesive selected from the group consisting of vinyl chloride and vinyl chloride-vinyl acetate polymer disposed only at the meeting surfaces of the laminae.

Process of Suppressing Foam Formation in Distillation of Acrylonitrile. No. 2,777,807. Cyrus Pyle and Gilbert Meredith Turner, New Castle, Del. (to E. I. du Pont de Nemours and Co., Wilmington, Del.)

In a continuous process for distilling acrylonitrile and water mixtures in a fractionating column, in which the two substances are fed into the column near the top, foam is suppressed by the addition of at least five parts per million of a foam suppressant consisting of tricresyl phosphate.

Equipment

Packing for Screw Extrusion Presses. No. 2,767,430. Zareh Lorenian, Milan, Italy.

The press has a casing in which a tubular press-screw revolves. A sealing device has a ring-shaped part positioned in the delivery end of the screw, and a second ring-shaped part is disposed in the direction of material flow, and which forms a radial seal with the sealing surface of the first part. The second part is tapered in the direction of material flow, so that back pressure forces it to slide toward the rear. Its forward end tapers to form a flexible lip which, under load, presses against the exterior sealing surface to prevent back flow of the material.

Apparatus and Method for Producing Embossed Thermoplastic Film. No. 2,776,451. Marc A. Chavannes, New York, N. Y. (to Chavannes Industrial Synthetics, Inc., New York, N. Y.)

The apparatus, for low pressure embossing of thermoplastic film having a narrow softening temperature range, consists of a means for feeding the film to a continuously rotating roller; means for heating the film while on the roller; and a cool porous embossing roller, positioned so as to receive the hot film from the first roller without a substantial loss of heat. The rollers are rotated in opposite directions, causing the film to advance along an S-shaped path. Suction is applied to the interior of the embossing roller to emboss the film where it is first engaged, and means are provided for removing the embossed film from the roller.

Apparatus for Embossing Thermoplastic Film. No. 2,776,452. Marc A. Chavannes, New York, N. Y. (to Chavannes Industrial Synthetics, Inc., New York, N. Y.)

The apparatus consists of a porous embossing roller, means for advancing the film around an arcuate portion of the roller, and a means for heating the film prior to its first engagement. The embossing roller is a perforated metallic sleeve having a design-bearing fabric sleeve bonded to its outer surface, and provided with means to produce an air suction from within. The air suction draws the hot film against the fabric sleeve to perform the embossing operation. The sleeve member is readily removable, and may be replaced by another sleeve member having a fabric sleeve of different design.

Web Winding Apparatus. No. 2,777,644. Frank R. Nicholson, Buffalo, N. Y. (to E. I. du Pont de Nemours and Co., Wilmington, Del.)

The apparatus consists of a positively-driven shaft carrying a multiplicity of spaced driving members that rotate with the shaft. Each primary member is aligned with a secondary driving member rotatably mounted on a stationary shaft and connected by a power-transmitting linkage. A plurality of pivot arms is rotatably mounted on the stationary shaft, each of which is positioned next to a secondary drive. A rotatable core supporting means is mounted on the free end of each arm and connected to the secondary drive by a power-transmitting linkage. A core, rigidly mounted on each of the supports, receives the web as it is wound by the action of a web driving roll.

Spraying Apparatus for Successive Articles Carried By a Conveyor. No. 2,777,419. Jens A. Paasche, Chicago, Ill. (to Cline Electric Mfg. Co., Chicago, Ill.)

The apparatus is a spraying mechanism consisting of a base; a track composed of three rods mounted on the base in triangular relationship with their axes parallel and fixed against longitudinal movement relative to each other; means for carrying a spraying device along the rods including a pair of spaced-apart plates located on either side of one of the rods; a pair of wheels mounted between the plates and contacting the rod at longitudinally spaced points; and a wheel means attached to the carriage and contacting each of the other two rods to provide both longitudinal and transverse three-point support.

Apparatus for Continuously Forming Plastic Tubing. No. 2,777,501. Herbert C. Fischer, Wellesley Hills, Mass. (to National Fiber Glass Co., Inc., West Hanover, Mass.)

The apparatus is a tube-forming machine with a mandrel having a tip portion projecting into the tube as it is formed. A forming surface is provided by a plurality of endless conveyor elements, the return portions of which are disposed within a return conduit. Actuating means are connected with the conveyor elements for advancing them to move the tube-forming surface toward the tip of the mandrel. A wrapper, provided with means for rotation about the longitudinal axis of the mandrel, provides support for a strip of organic plastic material. The wrapper winds the strip material about the conveyor tube support at an overlapping lead angle.

Vinyl Acetate Reactor. No. 2,777,760. Francis H. Dineen, Niagara Falls, N. Y., Samuel A. McNeight, Richland, Wash., and William H. Vining, Niagara Falls, N. Y. (to E. I. du Pont de Nemours and Co., Wilmington, Del.)

The reactor consists of a vertical, elongated, cylindrical chamber for containing fluidized solids; a gas-inpervious cone located coaxially in the lower part of the chamber; and means for flowing fluidized gases upward through the annular space between the cone base and the side walls of the chamber. The cone has a base area between ¼-¾ the cross-sectional area of the chamber. Its conical surface has an angle greater than the angle of repose of the particulate solids, and its apex extends to a vertical height not exceeding three-fifths of the reaction chamber height.

Processing

Plastic Container. No. 2,767,754. Frederick E. Lederer, Chicago, and Benjamin M. Levin, Jr., Glencoe, Ill.

The packaging container for frozen foods comprises a receptacle of rectangular shape with side walls converging downwards. These are joined at their mutual junctures with minor radius fillets, and a parapet flange defines the outermost periphery. The disc closure is made of laminated sulphite board, and the container itself of polyethylene film.

Soft Plastic Food Package. No. 2,770,547. Leo Peters, Grand Rapids, Mich.

The package comprises an open-ended tubular container with walls of unsupported thermoplastic sheet, and having a thickness of 0.008-0.03 inch. The decorated walls are unsupported externally, and the soft food on the inside takes on the impression of the decorative design. The material itself should be capable of bending through a 180° arc without forming a crease.

Thermoset Synthetic Resin Laminate with Undercut Surface and Method of Making Same. No. 2,768,923. Charles G. Kepple and William C. Weltman, Pittsburgh, Pa. (to Westinghouse Electric Corp., East Pittsburgh, Pa.).

The surface sheet is impregnated with a synthetic varnish and dried to a tack-free condition. A thin coating of adhesive resin is applied, followed by a layer of granular particles. Following solvent evaporation, the sheet is laminated to the resinous under-sheets by means of heat and pressure.

Methods of Forming Smooth Surfaces on Thermoplastic Sponge. No. 2,767,436. Robert L. Noland, Duarte, Calif., and Victor M. Sanders, Azusa, Calif.

The thermoplastic sponge material is heated to a temperature in excess of the softening point in a preheated die which conforms to the shape of the desired object. A closing force, less than that required to exceed the compressive strength of the material, is applied to the die. The die is cooled immediately to a temperature below the material's softening point, and the molded article is removed.

Method and Apparatus for Providing a Permeable Tube with an Impermeable Lining. No. 2,767,431. Leonce Kraffe de Laudarede, Paris, France.

Thermoplastic material is extruded as a ring within a continuously-advancing permeable tube. Air, under pressure, is directed into the center of the tube causing the plastic to swell and form an impermeable seal.

Pearlescent Plastic Materials. No. 2,767,434. James H. Fortune, Springdale, Conn. (to American Cyanamid Co., New York, N. Y.).

Pearlescent effects are produced in non-hydrophilic compositions by incorporating 0.1-5% by weight of a water-soluble wetting agent. After molding, the product is immersed in hot water.

Method of Molding a Plastic Blank Upon a Hollow Form. No. 2,777,165. Victor H. Hurt, Cranston, R. I. (to United States Rubber Co., New York, N. Y.)

The method provides a hollow molding form that has perforations in the molding area, the interior of which is completely closed to the passage of fluid except through the perforations. A plastic blank having the same approximate size and shape as the molding area is positioned on the form with its edges sealed against a non-perforated area. The blank and form are then subjected to an elevated temperature, while a fluid pressure is applied externally to provide a pressure differential across the form to mold the hot blank to the desired shape.

Method of Coating Glass Fibers With Reaction Product of Organo Halsilanes and Glycidol Derivatives and Then With Epoxy Resins and the Product Per Se. No. 2,776,910 Porter W. Erickson, Silver Spring, and Irving Silver, Mount Rainier, Md. (to Secretary of the Navy, United States of America.)

A method of finishing siliceous reinforcement to improve its adhesion to resin in laminates which consists of treating the reinforcement with the reaction products of a compound selected from the class consisting of methyl trihalosilane, vinyl trihalosilane, and allyl trihalosilane; and a compound selected from the class consisting of glycidyl allyl ether and glycidyl methacrylate.

Process For Spinning Aqueous-Saline Solutions of Acrylonitrile Polymers. No. 2,777,751. Arthur Cresswell, Stamford, and Percival W. Cummings, Jr., Cos Cob, Conn. (to American Cyanamid Co., New York, N. Y.)

A acrylonitrile polymerization product, dissolved in an aqueous solution of water-soluble thiocyanate so as to contain a major proportion, by weight, of combined acrylonitrile, is extruded through a shaped orifice into a liquid coagulating bath to form a shaped structure. The bath, itself an aqueous solution containing from 3-25%, by weight, of water soluble thiocyanate, is maintained at a temperature not exceeding 10° C.

Applications

Molded Plastic Container. No. 2,777,492. Harry M. Kikuchi, Cleveland, O.

A molded flexible pouch comprising two generally parallel side portions joined by an arcuate wall portion, and having an integral tray projecting outwardly from the mouth. The tray is an extension of one of the sides. A flange about the edge of the tray, and normal to it, follows an arcuate contour corresponding to the outer side of the pouch wall which enables it to snugly grasp the wall when the tray is flexed against it. A tab extending from the end of the pouch opposite the mouth is gripped by a notch and lug in the free edge of the flange.

Dyeable Polyesters. No. 2,777,830. Joseph Clois Shivers, Jr., West Chester, Pa. (to E. I. du Pont de Nemours and Co., Wilmington, Del.)

A shaped article is prepared from a linear fiber-forming polymeric dicarboxylic acid-diglycol ester by a hot-melt extruding process. The ester, having an imido side group which is converted by hydrolysis with hydrazine, then is dyeable with acid dyes.

Plastic Packing. No. 2,776,154. George P. Leistensnider, Somerville, N. J. (to Johns-Manville Corp., New York, N. Y.).

A plastic packing extruded in the form of a helical strip, from which suitable lengths may be taken and applied in helical or annular form to a movable shaft. The components of the packing, thoroughly intermixed, are maintained within the following approximate ranges: fiber, 10-80%; heat resistant binder, 5-30%; and a non-fluid lubricating substance, 10-70%.

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12-V-64	lb.	.68 /	.70
19-V-1	lb.	.52 /	.54
24-V-1	lb.	1.10 /	1.12
128-V-5	lb.	.86 /	.88

Wetting Agents

Merix Wash Concentrate	lb.	2.59 /	3.69

CALENDAR of COMING EVENTS

June 16-21
ASTM Annual Meeting. Chalfonte-Haddon Hall Hotel, Atlantic City, N. J.

Sept. 17-18
Fourth meeting, Plastics Study Group, Building Research Inst. Washington U., St. Louis, Mo.

Sept. 18
SPE New York Section. Governor Clinton Hotul, New York, N. Y.

Sept. 25
Reinforced Plastics Group. SPE New York Section. Tufaro's Restaurant, Corona, L. I., N. Y.

Oct. 3
SPE Western New England Section. Terrace Rm., Bradley Field, Windsor Locks, Conn.

Oct. 4
SPE Southern California Section. Scully's Restaurant, Los Angeles, Calif.

Oct. 8
SPE Milwaukee Section. Bavarian Club, Milwaukee, Wisc.

Oct. 7-9
Paper-Plastics Conference, Technical Assoc. of the Pulp & Paper Industry. Sheraton-Gibson Hotel. Cincinnati, O.

Oct. 10-11
SPI annual New England Section Conference. Wentworth Hotel, Portsmouth, N. H.

Oct. 11
SPE Connecticut Section. Hotel Barnum, Bridgeport, Conn.

Oct. 14
SPE Cleveland-Akron Section. Spanish Tavern, Brecksville, O.

Oct. 16
SPE New York Section. Governor Clinton Hotel, New York, N. Y.

Oct. 17
SPE Pittsburgh Section. Cappy's Restaurant, Pittsburgh, Pa.

Oct. 21
SPE Upper Midwest Section. Warwa's Cafe, Minneapolis, Minn.

Oct. 22
SPE Philadelphia Section. Franklin Inst., Philadelphia, Pa.

Oct. 23
Reinforced Plastics Group. SPE New York Section. Tufaro's Restaurant, Corona, L. I., N. Y.
SPE Quebec Section. Queen's Hotel, Montreal, P. Q., Canada

Domestic Production and Sales of Plastics and Resin Material, January and February, 1957

Following are the partly estimated and revised statistics for the domestic production and sale of plastics and resinous material during the months of January and February, 1957. Units listed are in pounds, dry basis unless otherwise specified. Data on alkyds and rosin modifications have not been included since their use is primarily limited to the protective coating industry.

Since this is the start of a new year, we will compare figure with the same two months of 1956. The over-all picture is pretty much predictable: big gains for Polyethylenes; appreciable gains for Vinyls and Polyesters; losses for Phenolics, Ureas, and Coumarone-Indenes; and virtually no change in the other categories.

	January, 1957		February, 1957	
	Production	Sales	Production	Sales
Cellulose Plastics:[1]				
Cellulose acetate and mixed ester:				
Sheets, under 0.003 gage	1,440,428	1,309,744	1,483,744	1,462,267
Sheets, 0.003 gage and over	1,438,472	1,217,714	1,279,494	1,252,924
All other sheets, rods, and tubes	612,021	513,768	528,625	546,737
Molding and extrusion materials	7,455,973	7,000,531	7,186,777	7,040,799
Nitrocellulose sheets, rods, and tubes	376,988	488,843	429,089	350,892
Other cellulose plastics	524,756	307,948	374,656	330,597
TOTAL	11,848,638	10,838,546	11,282,385	10,984,216
Phenolic and Other Tar-Acid Resins:				
Molding materials[1]	17,558,707	16,674,519	15,448,355	14,363,909
Bonding and adhesive resins for—				
Laminating (except plywood)	5,211,501	4,053,993	4,733,850	3,659,132
Coated and bonded abrasives	1,692,440	1,670,029	1,534,146	1,307,289
Friction materials (brake linings, clutch facings, and similar materials)[2]				
Thermal insulation (fiber glass, rock wool)	4,458,990	4,242,148	3,978,184	3,830,952
Plywood	3,755,541	2,834,587	3,774,409	2,706,209
All other bonding and adhesive uses	4,913,746	4,415,928	4,028,718	3,632,541
Protective-coating resins, unmodified and modified except by rosin	2,709,587	2,414,651	2,669,902	2,024,221
Resins for all other uses	3,782,269	3,266,772	3,566,290	3,009,628
TOTAL	44,082,781	39,572,627	39,733,854	34,533,881
Urea and Melamine Resins:				
Textile-treating and textile-coating resins	3,398,043	3,461,405	3,216,719	3,281,678
Paper-treating and Paper-coating resins	2,545,736	2,318,543	2,376,871	2,171,645
Bonding and adhesive resins for—				
Plywood	7,338,293	7,257,214	7,250,091	7,248,689
All other bonding and adhesive uses, including laminating	2,158,213	2,268,577	2,564,824	2,118,002
Protective-coating resins, straight and modified	3,488,263	2,630,258	2,836,442	2,126,599
Resins for all other uses, including molding	7,657,056	7,874,611	7,147,440	6,899,552
TOTAL	26,585,604	25,810,888	25,392,387	23,846,165
Styrene Resins:				
Molding materials[1]	32,295,697	36,093,284	33,446,376	31,783,278
Protective-coating resins, straight and modified	7,428,840	6,900,748	6,893,495	6,522,608
Resins for all other uses	11,211,112	9,874,756	12,650,240	9,593,468
TOTAL	50,935,649	52,868,788	52,990,111	47,899,354
Vinyl and Vinyl Chloride Resins:[3]				
Polyvinyl chloride and copolymer resins (50% or more PVC) for—				
Film (resin content)		8,094,174		8,669,487
Sheeting (resin content)		5,760,834		4,564,239
Molding and extrusion (resin content)		18,804,807		19,804,902
Textile and paper treating and coating (resin content)[3]		6,196,842		5,136,576
Flooring (resin content)		5,957,804		6,220,833
Protective coating (resin content)		3,076,650		2,681,788
All other uses, (resin content)		3,438,158		3,257,510
All other vinyl resins for—				
Adhesives (resin content)		2,987,842		3,255,313
All other uses (resin content)		10,407,527		9,528,941
TOTAL	67,096,334	64,724,638	64,004,784	63,119,589
Coumarone-Indene and Petroleum Polymer Resins	17,643,660	18,431,928	18,319,951	18,427,722
Polyester Resins	7,264,772	6,443,851	7,186,888	6,098,661
Polyethylene Resins	52,393,768	53,187,799	49,800,274	43,666,576
Miscellaneous Synthetic Plastics and Resin Materials:				
Molding materials[1,4]	4,654,617	4,541,667	3,824,213	3,990,393
Protective-coating resins[5]	1,170,018	483,276	1,190,350	516,167
Resins for all other uses[6]	10,174,445	10,312,804	9,256,220	8,935,352
TOTAL	15,999,080	15,337,767	14,270,783	13,441,912
GRAND TOTALS	293,850,286	287,216,832	282,981,307	262,018,076

[1] Includes fillers, plasticizers, and extenders.
[2] Production statistics by uses are not representative, as end use may not be known at time of manufacture.
[3] Includes data for spreader and calendering-type resins.
[4] Includes data for acrylic, nylon, silicone, and other molding materials.
[5] Includes data for epichlorohydrin, acrylic, silicone, and other protective-coating resins
[6] Includes data for acrylic, rosin modifications, nylon, silicone, and other plastics and resins for miscellaneous uses.
Included with "All other bonding and adhesive uses."
SOURCE: United States Tariff Commission, Chemical Division.

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